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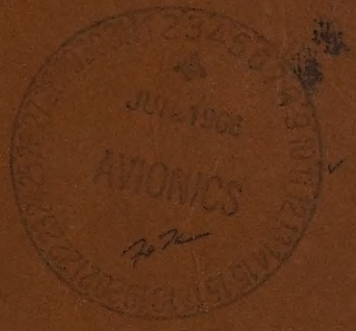
COLLINS

overhaul manual

(with illustrated parts catalog)

Cedar Rapids Region | Collins Radio Company, Cedar Rapids, Iowa

614L-8
ADF Control Unit



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(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
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(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

TD-577B
523-0755493-601113
15 July 1962
6th Revision, 15 November 1966

COLLINS

overhaul manual

614L-8
ADF Control Unit

©Collins Radio Company 1962, 1963, 1964, 1965
Second Printing November 1966

Collins Radio Company | Cedar Rapids, Iowa
Printed in U.S.A.

614L-8 ADF Control Unit

List of Effective Pages

Page No.	Issue
Cover	Dec 1/65
*Title	Nov 15/66
*A	Nov 15/66
*Rec of Rev	Nov 15/66
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*iv thru v	Nov 15/66
vi	Dec 1/65
1	Dec 1/65
*2	Nov 15/66
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*706	Nov 15/66
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1109	Dec 1/65
1110 Blank	Dec 1/65
1111	Dec 1/65
1112 Blank	Dec 1/65
*1113 thru 1118	Nov 15/66
1119	Dec 1/65
*1120	Nov 15/66

* The asterisk indicates pages changed, added, or deleted by the current change.

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Record of Revisions

614L-8 ADF Control Unit	LOCATION
ASSIGNED TO (JOB TITLE)	

REV. NO.	REVISION DATE	INSERTION DATE	BY	REV. NO.	REVISION DATE	INSERTION DATE	BY
1	April 1/63						
2	Jan 1/64						
3	June 1/64						
4	July 1/65						
5	Dec 1/65						
6	11/15/66	1/6/67	+				
7							

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COLLINS RADIO COMPANY

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Cedar Rapids, Iowa 52406 telephone: area code 319, 365-8411 cable: COLINRAD

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November 15, 1966

TO: HOLDERS OF 614L-8 ADF CONTROL UNIT OVERHAUL MANUAL (WITH ILLUSTRATED PARTS CATALOG)

REVISION NO. 6 HIGHLIGHTS

Revised pages for the illustrated parts catalog section of the 614L-8 Overhaul Manual were inadvertently omitted from the set of revised pages you recently received. These pages accompany this letter, along with a new covering letter. Please replace the corresponding pages of your manual, and substitute the attached covering letter for the one you previously received.

TECHNICAL PUBLICATIONS

COLLINS

Cedar Rapids, Iowa 52406 Area Code 319 365-8411 Cable : COLINRAD

November 15, 1966

TO: HOLDERS OF 614L-8 ADF CONTROL UNIT OVERHAUL MANUAL (WITH ILLUSTRATED PARTS CATALOG)

REVISION NO. 6 HIGHLIGHTS

Pages which have been revised are listed below with descriptions and reasons for the changes. Determine the revised pages which are applicable to your equipment. Replace the corresponding pages of your manual. Retain this letter of transmittal for future reference.

PAGE	DESCRIPTION OF REVISION AND REASON FOR CHANGE	SERVICE BULLETIN	EFFECTIVITY
v	Added 137A-6B Fixed Loop Antenna		All
2, 706, 803/804	Added 022 status to 614L-8 ADF Control Unit		All
803/804, 805/806, 807/808	Corrected drawing errors and changed figure titles		All
	Updated IPC to include new status.		

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1-3-67

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FOREWORD

Included within this manual are overhaul instructions with an illustrated parts list prepared in conformance with ATA Specification No. 100 for Manufacturers' Technical Data for the 614L-8 ADF Control Unit.

The overhaul instructions are presented in the following sections: description and operation; disassembly; cleaning; inspection/check; repair; assembly; testing; troubleshooting; storage instructions; special tools, fixtures, and test equipment; and an illustrated parts list.

The standards presented in this manual preclude their use for acceptance testing. The information enables the user to restore equipment, which has been removed from service, to proper operating condition.

The following is a list of related publications.

PUBLICATION	COLLINS PART NO.
DF-203 ADF System, Maintenance Manual (with installation data)	523-0755450
51Y-4/4A ADF Receiver, Overhaul Manual (with illustrated parts list)	523-0755938
179J-5/6/7/8 Sense Antenna Couplers, Overhaul Manual (with illustrated parts list)	523-0755502
DF-203 ADF System RF Cables, Overhaul Manual, (with illustrated parts list)	523-0755504
137A-4/5/6/6A Fixed Loop Antennas, Overhaul Manual (with illustrated parts list)	523-0755617
Electromechanical Components, Overhaul Manual	523-0757895

614L-8 ADF Control Unit (Typical)
Figure 1

614L-8 ADF Control Unit - Description and Operation

1. GENERAL.

Included within this section is the purpose of equipment, the equipment specifications, the equipment description, and theory of operation. Refer to figure 1 for an overall view of a typical 614L-8 ADF Control Unit. Figure 2 is a table of equipment covered in this manual. Figure 3 shows equipment details which distinguish 614L-8 ADC Control Units by part number.

NOMENCLATURE	FUNCTION	COLLINS PART NUMBER
614L-8 ADF Control Unit	Control unit for DF-203	(See figure 3.)

Table of Equipment Covered
Figure 2

COLLINS PART NUMBER	DISTINGUISHING FEATURES
522-2357-00	28-volt, red panel lamps and dial lamps, PT02A-20-41P connector, black panel.
522-2357-011	28-volt, white panel lamps and dial lamps, PT02A-20-41P connector, black panel.
522-2357-012	5-volt, red panel lamps and dial lamps, PT02A-20-41P connector, black panel.
522-2357-013	5-volt, white panel lamps and dial lamps, PT02A-20-41P connector, black panel.
522-2357-014	5-volt, white panel lamps and dial lamps, black panel MS-24264R-18B31P connector, black panel.
522-2357-016	5-volt, white panel lamps and dial lamps, MS-24264R-18B31P connector, gray panel.

Table of Equipment Details (Sheet 1 of 2)
Figure 3

COLLINS PART NUMBER	DISTINGUISHING FEATURES
522-2357-017	5-volt, white panel lamps and dial lamps, PT02A-20-41P connector, black panel. Gray function and band selector knobs with black skirts. Gray LOOP knob. Black TUNE and GAIN knobs.
522-2357-018	28-volt, red panel lamps and dial lamps, MS-24264R-18B31P connector, gray panel and knobs. Special panel and dial drum.
522-2357-019	28-volt, white panel lamps and dial lamps, PT02A-20-41P connector, gray panel, black knobs.

Table of Equipment Details (Sheet 2 of 2)
Figure 3

2. PURPOSE OF EQUIPMENT.

The purpose of the 614L-8 ADC Control Unit is to provide control for the DF-203 ADF System. The 614L-8 remotely controls primary power, tuning, band-switching, gain, goniometer rotation (corresponding to loop rotation in earlier ADF systems), function switching, and bfo operation of the 51Y-4/4A ADF Receiver.

3. EQUIPMENT SPECIFICATIONS.

The 614L-8 ADF Control Unit specifications are listed in figure 4.

CHARACTERISTIC	SPECIFICATION
ARINC compliance	Characteristic 550
Electrical power requirement	
51Y-4/4A supply (supplied to 51Y-4/4A through 614L-8)	27.5 volts dc +10 percent -20 percent, 0.7 ampere (peak current of 1.6 amperes during switch operation) 26 volts ac +10 percent -20 percent, 380 to 420 cps, 0.63 ampere

Table of Equipment Specifications (Sheet 1 of 2)
Figure 4

CHARACTERISTIC	SPECIFICATION
Panel lamps	1.8 watts
Dial lamps	2.3 watts
Duty cycle	Continuous
Dimensions	
Height	2.5 inches
Width	5.0 inches
Length	3.0 inches
Weight	1.8 pounds
Ambient temperature range	-65°C (-85°F) to +85°C (+185°F), storage; -54°C (-65°F) to +55°C (+131°F), operating; -54°C (-65°F) to +65°C (+149°F), short time operating (30 minutes)
Altitude	Sea level to 45,000 feet
Shock	6 g operating, 15 g nonoperating, shock duration to be 10 milliseconds in all cases
Vibration	0.02-inch total excursion, with 3 g maximum, 5 to 55 cps constant 1.5 g, 55 to 500 cps

Table of Equipment Specifications (Sheet 2 of 2)
Figure 4

4. EQUIPMENT DESCRIPTION.

A. Mechanical Description.

The 614L-8 ADF Control Unit is an enclosed unit secured to the aircraft control console by four Dzus fasteners. The 614L-8 size and method of mounting comply with MIL-C-6781B specification.

The 614L-8 is supported by an aluminum mounting plate whose front surface lies flush with the control console surface. On the front of this plate is the plastic front panel; on the rear is an aluminum casting. The plastic panel is translucent and except for characters, has been painted. These characters are illuminated by six miniature lamps behind the plastic

panel and appear white or red depending upon the color of the lamp. The frequency dial is also made of translucent plastic. Frequency dial characters are illuminated by two miniature lamps placed at the center of the dial and appear the same color as the front panel characters. The frequency dial is viewed through a plastic window in the center of the panel. The window is engraved with an illuminated, white-filled hairline.

The aluminum casting fastened to the rear of the aluminum mounting plate provides a rigid support for the control components of the 614L-8. Moving parts ride in bronze bushings which have been pressed into the casting. The use of antibacklash gears and the rigidity of the casting provide a tight, high resolution tuning system.

The function switch, gain control knobs, band switch, and tuning knobs are mounted on concentric shafts. Accurate detent positioning of the function and band-switching shafts is accomplished through the use of machined detents and roller detent followers. The tuning shaft, frequency dial, and a synchro rotor shaft are geared together and are prevented from rotating past the band limits by a multirevolution stop on the tuning shaft. A mechanical linkage between the detented band-switch shaft and the frequency drum positions the drum so that only the characters of the band in use can be seen.

B. Electrical Description.

Connections to the 614L-8 are made through a PT02A-20-41P or MS-24264R-18B31P connector. Manually operated frequency band and function selector wafer switches are used to control the motor-driven 51Y-4/4A function and band switch. An attenuator (three ganged variable resistors) is used to control the audio and radio-frequency gain of the 51Y-4/4A. One section controls the rf gain, and the remaining two form a bridged T attenuator for audio gain control. A sensitive tuning meter (100 microamperes full-scale deflection) indicates a current value proportional to a rectified portion of the 51Y-4/4A if. signal. The TUNE control is mechanically connected to a synchro transmitter whose output controls the 51Y-4/4A tuning. A 5-position wafer switch controls the manual rotation of the 51Y-4/4A goniometer rotor by applying either phase of a phase signal from the 51Y-4/4A to the 51Y-4/4A loop servoamplifier.

C. Controls and Indicators.

All 614L-8 ADF Control Unit controls and indicators are listed in figure 5.

CONTROL/INDICATOR	FUNCTION
LOOP L-R switch	Provides fast or slow manual rotation of loop antenna in either clockwise or counterclockwise direction.
BFO/OFF switch	Control receiver bfo on or off.
Tuning meter	Provides visual aid while tuning receiver.

Controls and Indicators (Sheet 1 of 2)
Figure 5

CONTROL/INDICATOR	FUNCTION
Mode switch	Provides the following modes; OFF, ADF, ANT, LOOP. Controls power to the 51Y-4/4A receiver and remotely controls the band and mode switch in the 51Y-4/4A.
GAIN	Controls audio gain with mode switch in ADF position. Controls rf gain with mode switch in ANT or LOOP position.
Frequency dial	Provides visual indication for ADF receiver tuning.
Band switch	Provides selection of three bands; .19-.40, .40-.80, .80-1.75 mc. Controls band and mode switch motor in receiver in conjunction with mode switch. Controls frequency dial through a mechanical linkage so that calibration for selected band appears for viewing in frequency dial window.
TUNE control	Simultaneously controls rotary position of frequency dial and rotor of tuning control synchro transmitter.

Controls and Indicators (Sheet 2 of 2)
Figure 5

5. THEORY OF OPERATION.

A. General.

The following paragraphs describe the overall DF-203 system theory in addition to the 614L-8 circuit theory of operation. The theory includes a block diagram discussion followed by a detailed discussion of each stage. The block diagram theory also includes other components of the DF-203 system.

B. Block Diagram Theory.

The equipment block diagram is shown in figure 6.

The rf signal is coupled from the directional 137A-( ) Fixed Loop Antenna through the 582A/C-( ) Quadrantal Error Corrector to the rf resolver in the 51Y-4/4A. The angular position of the resolver rotor determines the amplitude and phase of the loop rf signal reaching the first tuned transformer. The first tuned transformer is selected by the band/mode switch motor from three transformers that cover the three frequency bands of the 51Y-4/4A. One transformer covers the range from 190 to 400 kc. A second covers the range from 400 to 840 kc. The third covers frequencies from 840 to 1750 kc.

The loop rf signal is amplified in the first loop amplifier Q1. A 90-degree phase shift is applied to the output of the first loop amplifier in ADF mode so the loop antenna and sense antenna rf signals are exactly in phase or 180 degrees out of phase. In LOOP mode, the phase-shift network is bypassed to avoid attenuation since the phase of the loop signal has no effect on operation in LOOP mode. The loop signal is disconnected from the remaining circuits at the switch preceding the phase-shift network in ANT mode since only the sense antenna signal is used in ANT mode. The loop signal is then amplified in the second loop amplifier in ADF and LOOP modes. In the ADF mode, the loop signal is modulated at 110-cps rate in the balanced modulator. The balanced modulator output is a double-sideband suppressed-carrier signal (two 110-cps sidebands). The 110-cps gating voltage applied to the balanced modulator is provided by the 110-cps oscillator. The loop signal bypasses the balanced modulator in LOOP mode and is applied directly to the second tuned transformer.

The sense signal originating in the sense antenna is transferred through the 179J-( ) Sense Antenna Coupler (51Y-4 only) to the second tuned transformer in ADF and ANT modes. The sense signal is not used in LOOP mode. The loop and sense signals are mixed in the second tuned transformer in ADF mode. The combined sense antenna carrier signal and double-sideband suppressed carrier loop signal form an amplitude-modulated signal which has a modulation frequency of 110 cps with depth of modulation determined by the angular difference between the resolver rotor position and its null position and with the phase of the modulation envelope determined by the direction from the null position of the resolver rotor. The sense signal is the only signal reaching the second tuned transformer in the ANT mode.

The combined sense and loop antenna signal is amplified in the rf amplifier and applied through double-tuned circuits to the mixer where the signal is mixed with the output of a CW local oscillator. The local oscillator frequency is always 142.5 kc higher than the signal from the rf amplifier, so the mixer output is always 142.5 kc. This is the intermediate frequency. The five if. amplifier stages amplify this signal and the audio sidebands but reject all other frequencies. The fifth if. stage drives an audio detector. The audio signal is amplified in an audio amplifier which is connected to the 614L-8 ADF Control Unit.

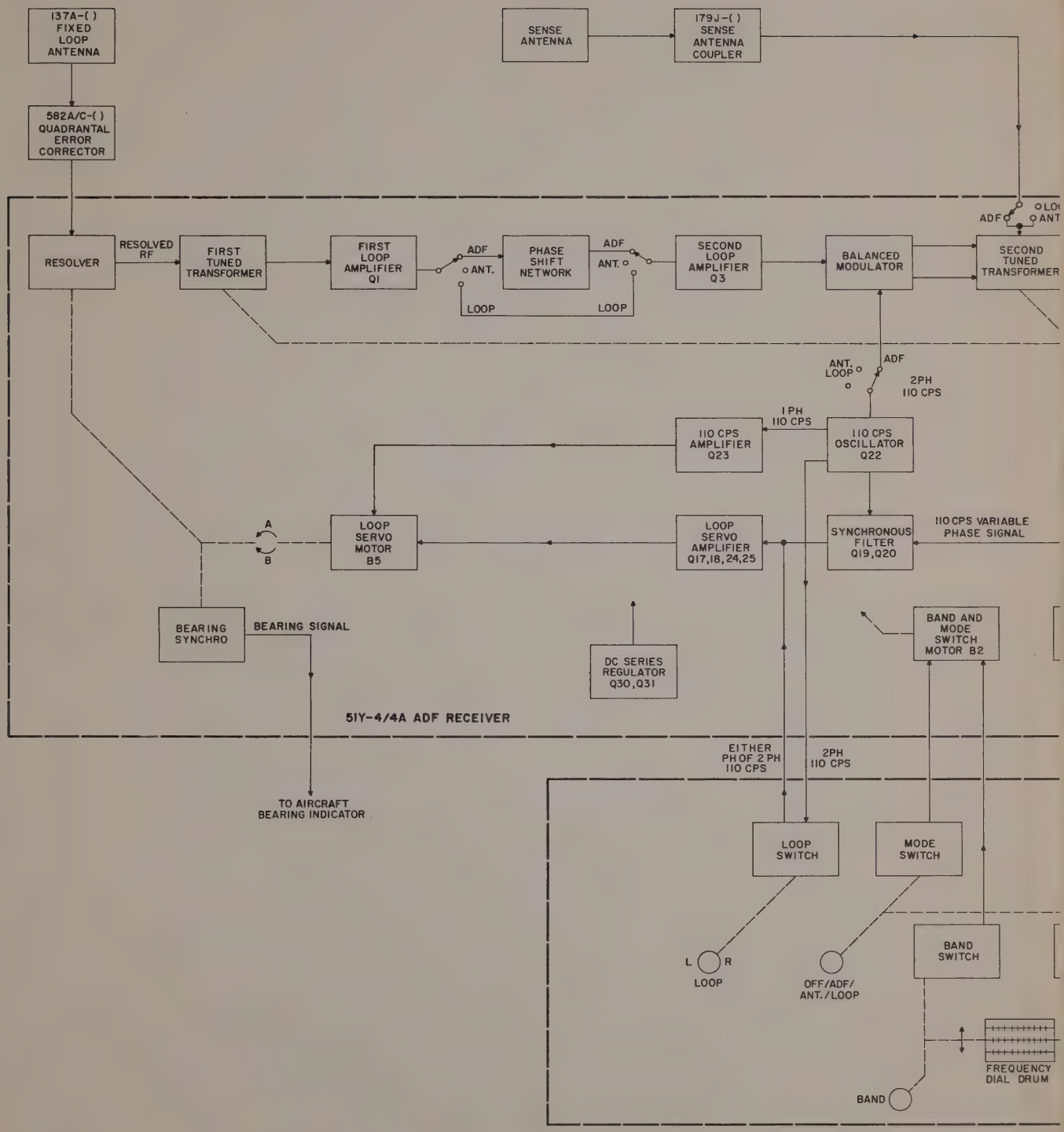
In ADF mode, the DF-203 audio output level is controlled by an audio attenuator in the 614L-8. The audio attenuator is bypassed in ANT and LOOP modes since 51Y-4/4A gain is controlled at the rf and if. stages by a dc bias voltage from the gain potentiometer in the 614L-8. In ADF mode, the 614L-8 gain potentiometer does not affect rf and if. gain.

The output of the fourth if. amplifier stage is demodulated with a diode detector and applied to the input of the agc amplifier and loop servoamplifier.

The dc component of the demodulated signal is amplified in the 2-stage agc amplifier to provide the agc voltage which is applied to the bases of the agc-controlled stages.

Rf and if. gain is varied by the agc amplifier in all modes. As the rf signal at the antenna increases, the increase in if. input to the agc amplifier reduces gain of the rf and if. stages. This prevents rapid changes in audio output and eliminates possible distortion from overloading.

The 110-cps ac signal from the detector is amplified in the loop servoamplifier, shifted in phase, and applied to the control winding of the loop servomotor. A synchronous filter in the low-level loop servoamplifier provides a very narrow passband. The center frequency of the passband is automatically synchronized with the 110-cps oscillator frequency. Audio signals, other than 110 cps are rejected to improve ADF performance. In ANT and LOOP



614L-8 ADF Control Unit (with Associated Equipment), Detailed Block Diagram
Figure 6

The loop rf signal is amplified in the first loop amplifier Q1. A 90-degree phase shift is applied to the output of the first loop amplifier in ADF mode so the loop antenna and sense antenna rf signals are exactly in phase or 180 degrees out of phase. In LOOP mode, the phase-shift network is bypassed to avoid attenuation since the phase of the loop signal has no effect on operation in LOOP mode. The loop signal is disconnected from the remaining circuits at the switch preceding the phase-shift network in ANT mode since only the sense antenna signal is used in ANT mode. The loop signal is then amplified in the second loop amplifier in ADF and LOOP modes. In the ADF mode, the loop signal is modulated at 110-cps rate in the balanced modulator. The balanced modulator output is a double-sideband suppressed-carrier signal (two 110-cps sidebands). The 110-cps gating voltage applied to the balanced modulator is provided by the 110-cps oscillator. The loop signal bypasses the balanced modulator in LOOP mode and is applied directly to the second tuned transformer.

The sense signal originating in the sense antenna is transferred through the 179J-( ) Sense Antenna Coupler (51Y-4 only) to the second tuned transformer in ADF and ANT modes. The sense signal is not used in LOOP mode. The loop and sense signals are mixed in the second tuned transformer in ADF mode. The combined sense antenna carrier signal and double-sideband suppressed carrier loop signal form an amplitude-modulated signal which has a modulation frequency of 110 cps with depth of modulation determined by the angular difference between the resolver rotor position and its null position and with the phase of the modulation envelope determined by the direction from the null position of the resolver rotor. The sense signal is the only signal reaching the second tuned transformer in the ANT mode.

The combined sense and loop antenna signal is amplified in the rf amplifier and applied through double-tuned circuits to the mixer where the signal is mixed with the output of a CW local oscillator. The local oscillator frequency is always 142.5 kc higher than the signal from the rf amplifier, so the mixer output is always 142.5 kc. This is the intermediate frequency. The five if. amplifier stages amplify this signal and the audio sidebands but reject all other frequencies. The fifth if. stage drives an audio detector. The audio signal is amplified in an audio amplifier which is connected to the 614L-8 ADF Control Unit.

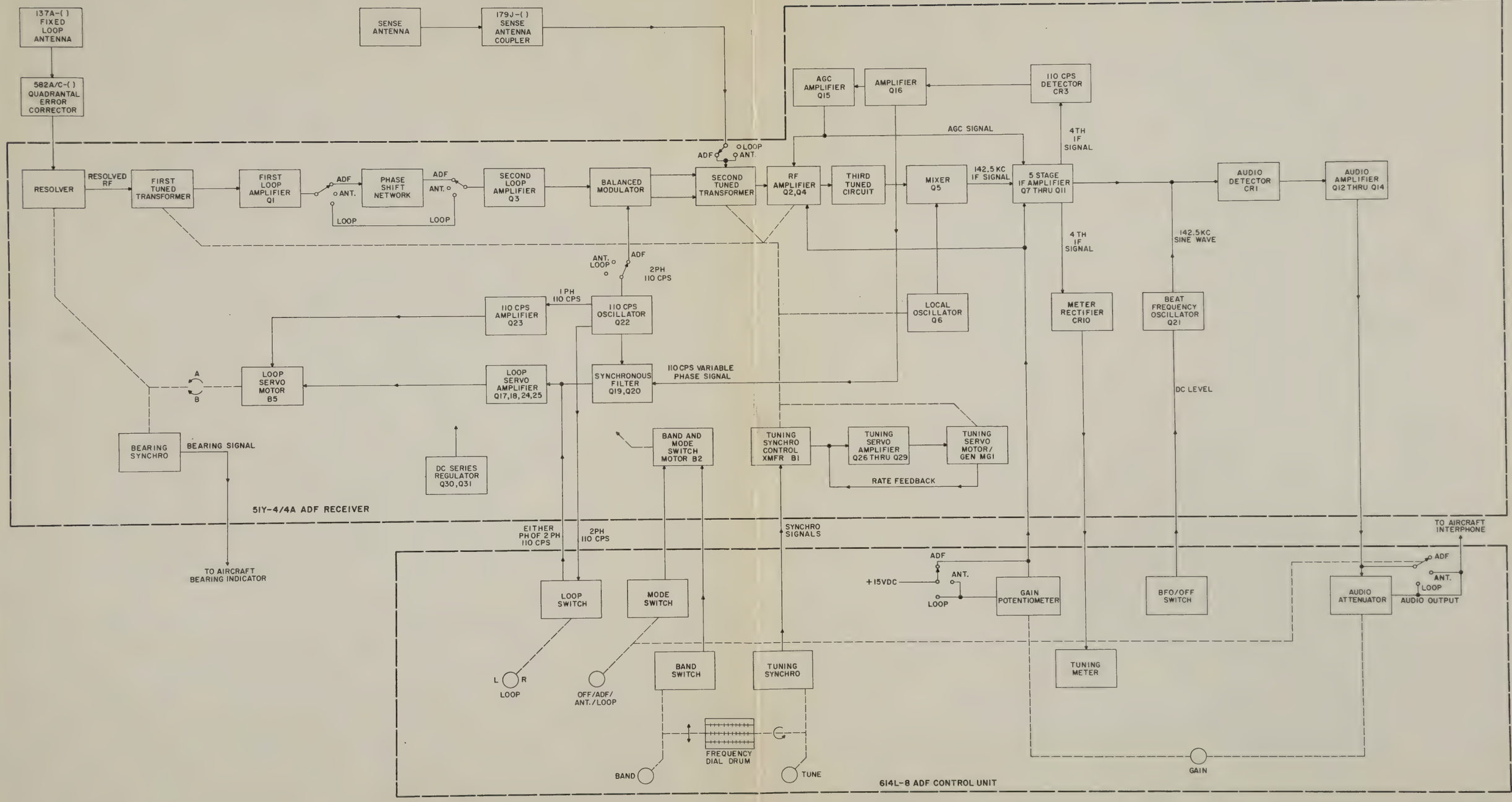
In ADF mode, the DF-203 audio output level is controlled by an audio attenuator in the 614L-8. The audio attenuator is bypassed in ANT and LOOP modes since 51Y-4/4A gain is controlled at the rf and if. stages by a dc bias voltage from the gain potentiometer in the 614L-8. In ADF mode, the 614L-8 gain potentiometer does not affect rf and if. gain.

The output of the fourth if. amplifier stage is demodulated with a diode detector and applied to the input of the agc amplifier and loop servoamplifier.

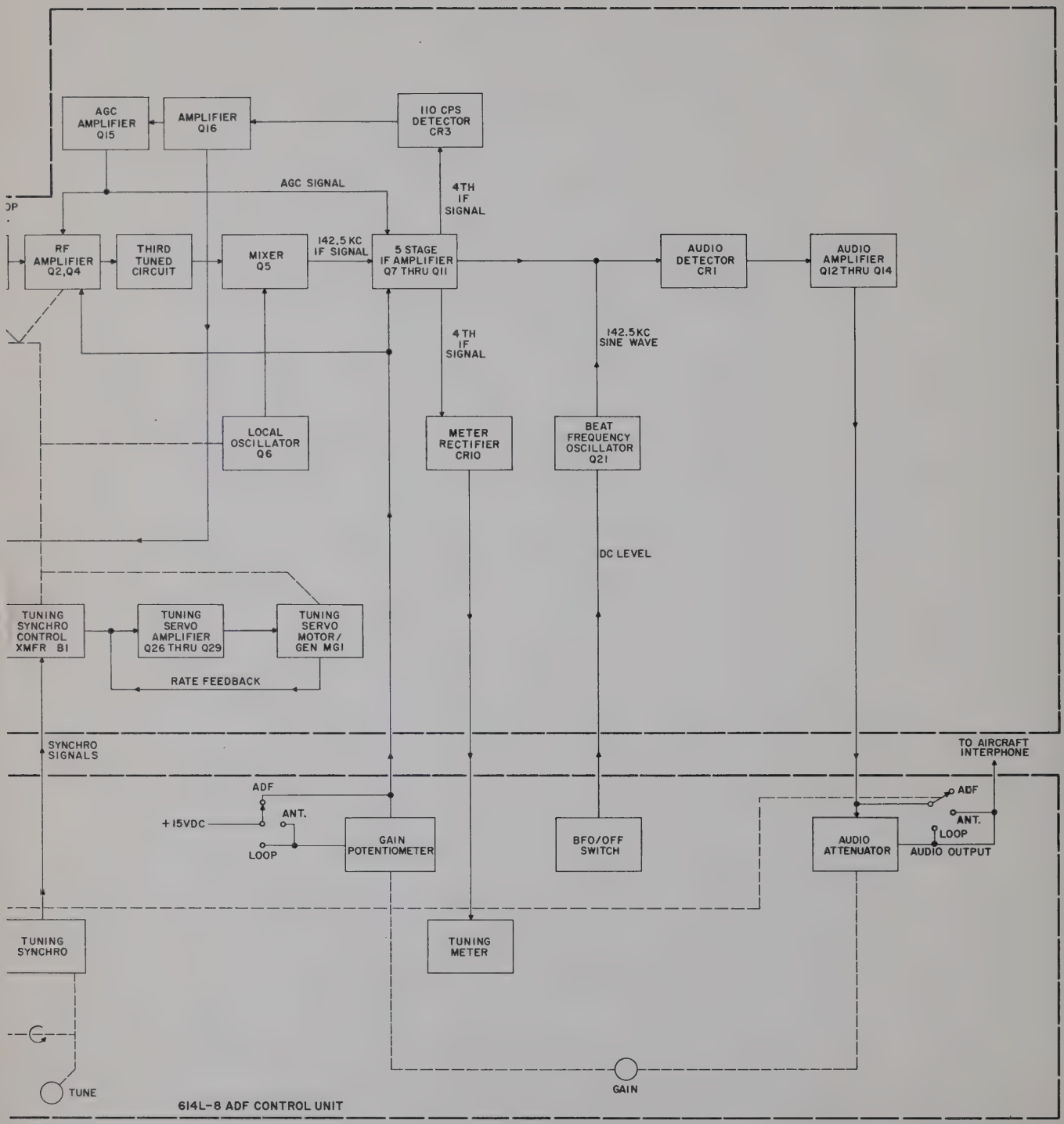
The dc component of the demodulated signal is amplified in the 2-stage agc amplifier to provide the agc voltage which is applied to the bases of the agc-controlled stages.

Rf and if. gain is varied by the agc amplifier in all modes. As the rf signal at the antenna increases, the increase in if. input to the agc amplifier reduces gain of the rf and if. stages. This prevents rapid changes in audio output and eliminates possible distortion from overloading.

The 110-cps ac signal from the detector is amplified in the loop servoamplifier, shifted in phase, and applied to the control winding of the loop servomotor. A synchronous filter in the low-level loop servoamplifier provides a very narrow passband. The center frequency of the passband is automatically synchronized with the 110-cps oscillator frequency. Audio signals, other than 110 cps are rejected to improve ADF performance. In ANT and LOOP



614L-8 ADF Control Unit (with Associated Equipment), Detailed Block Diagram
Figure 6


AGC AMPLIFIER Q15
AMPLIFIER Q16
110 CPS DETECTOR CR3
AGC SIGNAL
4TH IF SIGNAL
RF AMPLIFIER Q2,Q4
THIRD TUNED CIRCUIT
MIXER Q5
142.5 KC IF SIGNAL
5 STAGE IF AMPLIFIER Q7 THRU Q11
AUDIO DETECTOR CR1
AUDIO AMPLIFIER Q12 THRU Q14
4TH IF SIGNAL
142.5KC SINE WAVE
LOCAL OSCILLATOR Q6
METER RECTIFIER CR10
BEAT FREQUENCY OSCILLATOR Q21
DC LEVEL
TUNING SYNCHRO CONTROL XMFR B1
TUNING SERVO AMPLIFIER Q26 THRU Q29
TUNING SERVO MOTOR / GEN MG1
RATE FEEDBACK
SYNCHRO SIGNALS
TO AIRCRAFT INTERPHONE
ADF
+15VDC
ANT.
LOOP
GAIN POTENTIOMETER
BFO/OFF SWITCH
AUDIO ATTENUATOR
AUDIO OUTPUT
TUNING SYNCHRO
TUNING METER
TUNE
GAIN
614L-8 ADF CONTROL UNIT

modes, the 110-cps detector signal is disconnected from the loop servomotor. The second winding is energized by an amplified 110-cps reference signal from the 110-cps oscillator. The loop servomotor is geared to the resolver rotor. This motor can rotate in either direction and always drives a null in the figure-eight rotor pattern toward the signal source. Positioning of the rotor null toward the signal direction is accomplished automatically in ADF mode only. In LOOP mode, the loop servomotor and the rotor position are controlled manually from the LOOP L-R switch in the 614L-8. The rotor position is transferred to an external indicator by the bearing synchro system.

The beat-frequency oscillator (bfo) injects a 142.5-kc signal into the if. signal path. This signal creates an audio beat frequency when mixed with the 142.5-kc if. that is adjusted for a zero beat to attain proper tuning. The bfo may be switched on or off by the BFO/OFF switch on the 614L-8.

The fourth if. amplifier signal is also applied to the meter rectifier which causes the tuning meter to deflect in proportion to the if. signal strength.

The band and mode switches in the 614L-8 control the position of the band/mode switch of the 51Y-4/4A through the band/mode-switch motor. The band switch selects the proper rf transformers for each of the three bands into which the tuning range is divided. The mode switch interconnects and energizes the various circuits properly for each mode of operation. The band/mode-switch motor rotates only one switch which has many wafers and provides both mode-switching and band-switching functions.

The 51Y-4/4A tuning capacitor is positioned from the 614L-8 by a tuning synchro system. The tuning synchro transmitter is connected mechanically to the tuning knob and dial of the 614L-8. The synchro signal is transferred to the tuning synchro control transformer in the 51Y-4/4A. The control transformer output, with amplitude and phase dependent upon rotor position, is amplified and applied to the variable phase winding of the tuning servomotor. This motor is geared to the control transformer rotor which is driven to a null position by the motor. The motor also is geared to the tuning capacitor which is then driven with the control transformer rotor to the position selected in the 614L-8.

The dc supply voltage for the 51Y-4/4A transistors is provided by a voltage regulator. The voltage regulator receives power from the +27.5-volt dc aircraft primary power source and provides regulated +16-volt dc and +15-volt dc outputs.

C. Detailed Theory of Operation.

(1) General.

The detailed theory is presented in the following functional sequence: band and mode switching circuit, rf gain circuit, audio gain circuit, LOOP switch circuit, tuning meter, BFO switch, and tuning circuit.

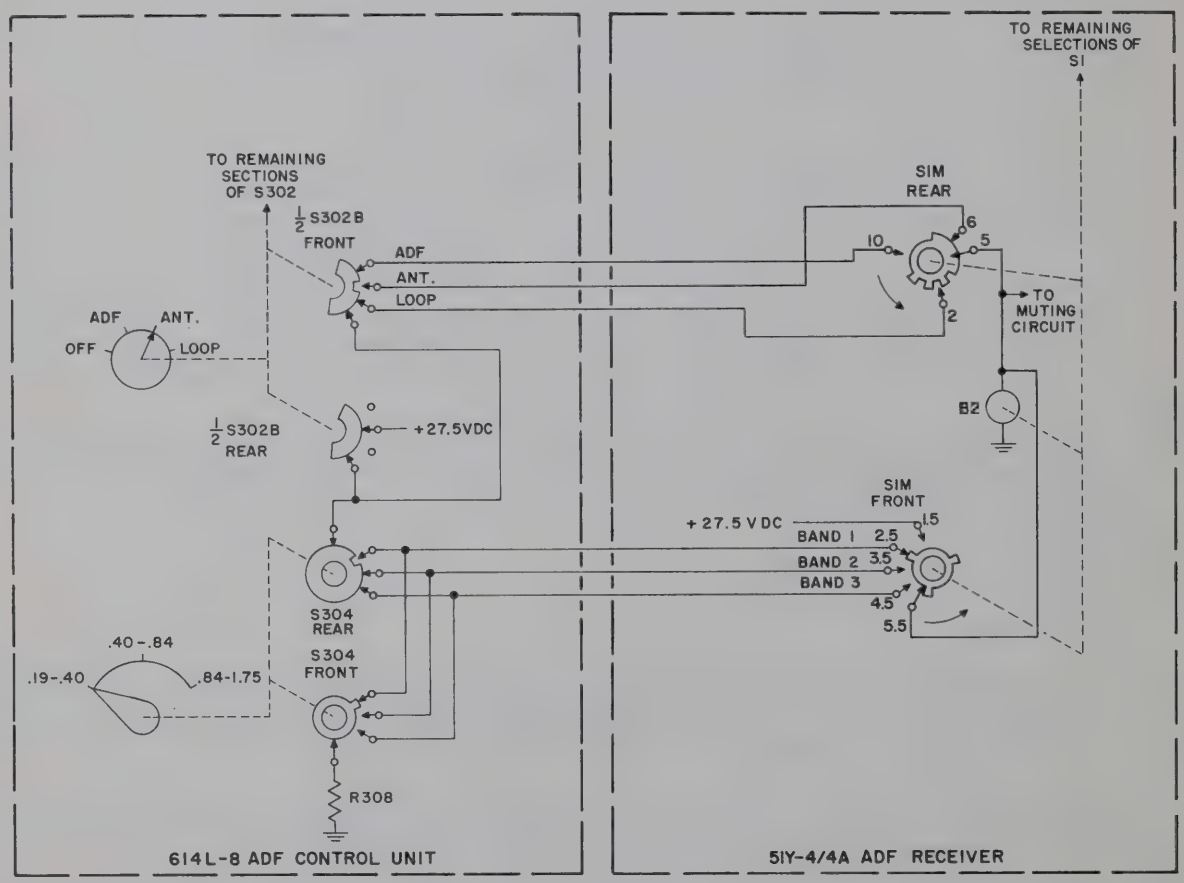
The main schematic is shown in figure 8 and can be used as an overall reference to supplement the information provided in the following paragraphs.

The types of signals received from, or applied to, the 51Y-4/4A ADF Receiver by these controls, and their significance to the operator, are also discussed.

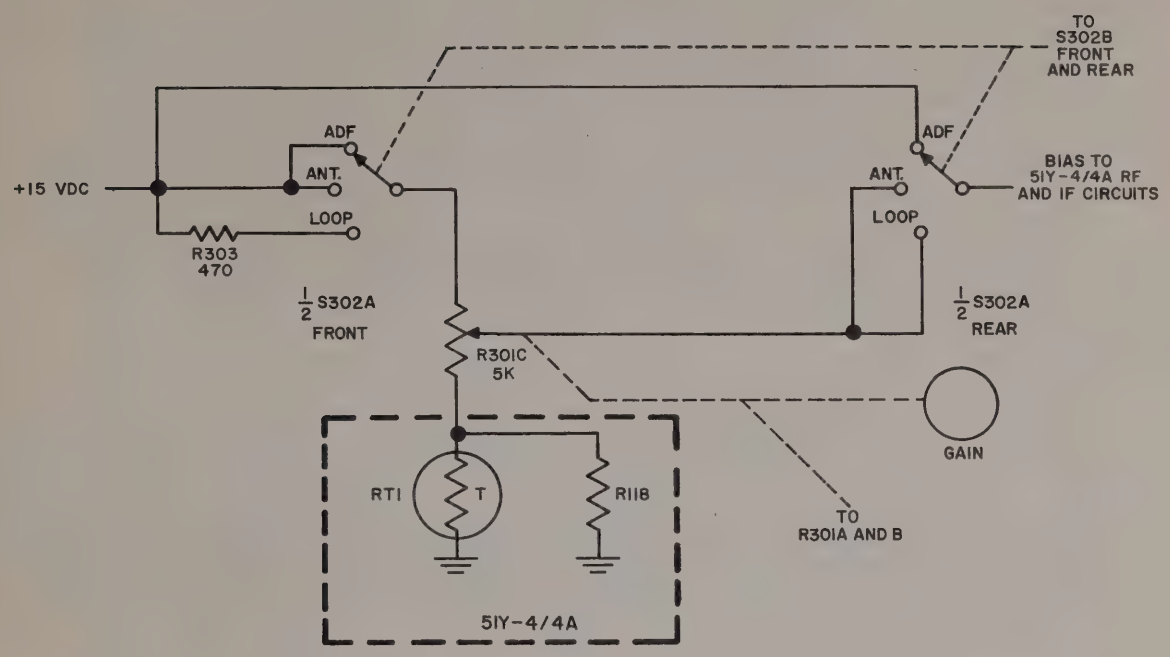
(2) Band and Mode Switching Circuit.

Control of the 51Y-4/4A band and mode selection is accomplished by the circuit shown in figure 7. The 614L-8 band and mode switches control a motor-driven switch on the 51Y-4/4A. The mode switch has four positions: OFF, ADF, ANT, and LOOP. The OFF position (switch S2B rear) removes primary power from the DF-203 ADF System. The band switch has three positions: .19-.40, .40-.84, and .84-1.75. There are nine operating combinations of switch positions, requiring nine positions of the 51Y-4/4A motor-driven switch to completely control the 51Y-4/4A band and mode selection. Switch contacts supply current to the 51Y-4/4A motor which drives the switch causing it to rotate past the blank positions.

Band switching is controlled by switch S304 rear in the 614L-8. Refer to figure 7. The circuit is shown in the .19-.40 position. If band switch S304 is positioned to the .40-.84 position, +27.5 volts dc is applied through the band 1 contact of switch S1M front to motor B2. Motor B2 rotates switch S1 in the direction shown by the arrows. As a tab



Band and Mode Switching Circuits, Simplified Schematic Diagram
Figure 7



RF Gain Circuit, Simplified Schematic Diagram
Figure 8

on S1M front reaches the band 2 contact, the motor stops because no voltage is present on the band 2 contact with S304 rear in the band 2 position. Switch S304 front grounds the motor armature through R308 for dynamic braking. The same procedure takes place for the band 3 position. Then the tab on S1M front moves off the band 1 contact; there is a midposition at which no power is applied to motor B2. To prevent the motor from stopping at the midposition, three small tabs on section S1M rear are provided. Each tab in turn provides power to the motor during midposition when switching frequency bands.

The DF-203 ADF System operating modes are selected by positioning switch S302B front on the 614L-8. Circuit operation is the same as that discussed for band switching. The large control tab of switch S1M rear covers four positions representing three bands and one blank position for each mode. Similar to the band-switching section, the mode switching section also has a midposition in which no power is applied to the 51Y-4/4A motor. This is the blank position and to prevent the motor from stopping on this position, +27.5 volts dc is applied to motor B2 through one of the tabs of S1M front.

(3) RF Gain Circuit.

The rf gain circuit is shown in figure 8. This circuit permits control of the rf gain of the 51Y-4/4A ADF Receiver from the 614L-8 ADF Control Unit in the ANT and LOOP modes. Control is accomplished by changing the bias voltage on the rf amplifier and two if. stages in the 51Y-4/4A. An increase in bias voltage causes a decrease in gain. When the mode switch is positioned to ADF, the rf gain cannot be varied and overall

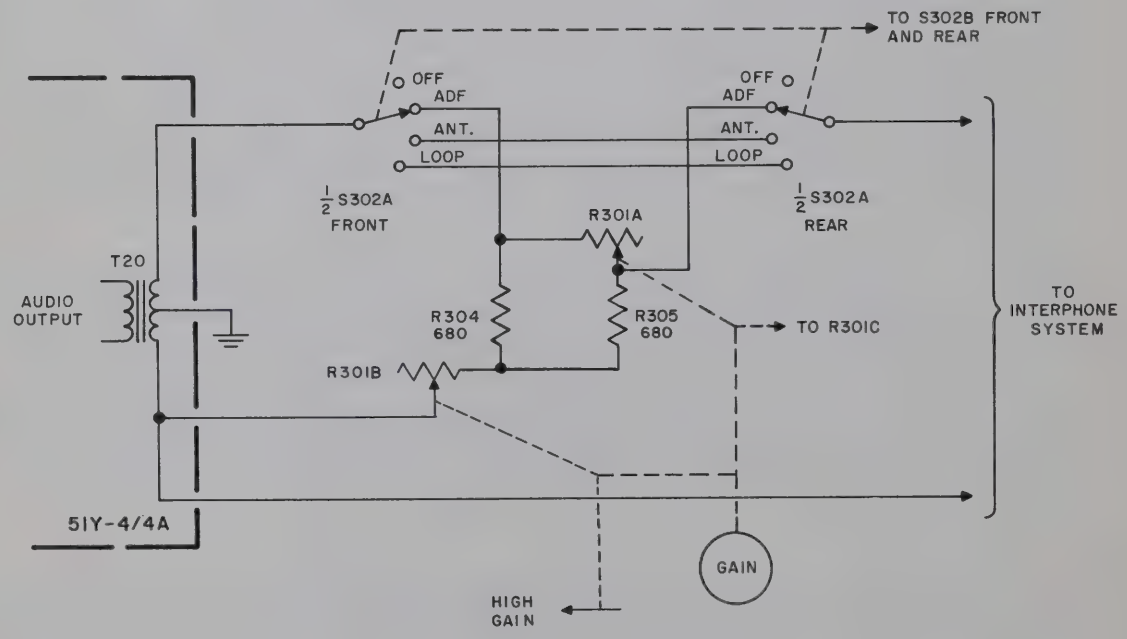
DF-203 gain is controlled by the audio gain circuit (paragraph (4)). The network composed of RT1 and R118 (located in the 51Y-4/4A) provides temperature compensation of the bias voltage. In the LOOP mode, resistor R303 is added to lower the gain of the 51Y-4/4A. This lowering of gain is required since the phase-shift network is bypassed in the 51Y-4/4A during LOOP mode. The phase-shift network, in addition to shifting the phase of the rf voltage in the 51Y-4/4A, also attenuates the signal. With the phase-shift network bypassed, high rf gain would make it difficult to obtain sharp nulls. With R303 added to the circuit, the rf gain is nearly the same in either ANT or LOOP mode for the same input level and gain control setting. The bias voltage is temperature compensated by thermistor RT1 in parallel with resistor R118.

(4) Audio Gain Circuit.

The circuit shown in figure 9 controls the audio gain of the DF-203. When the mode switch is in the ADF position, variable resistors R301A and R301B control the audio gain. The output of this unbalanced circuit presents a constant 600-ohm impedance to the aircraft interphone system. This impedance is required by the voice/range filter of the aircraft. When the mode switch is in the ANT or LOOP position, the variable resistor circuit is not used. Therefore, the audio output impedance of the 614L-8 is 600 ohms for all positions of the mode switch.

(5) LOOP Switch Circuit.

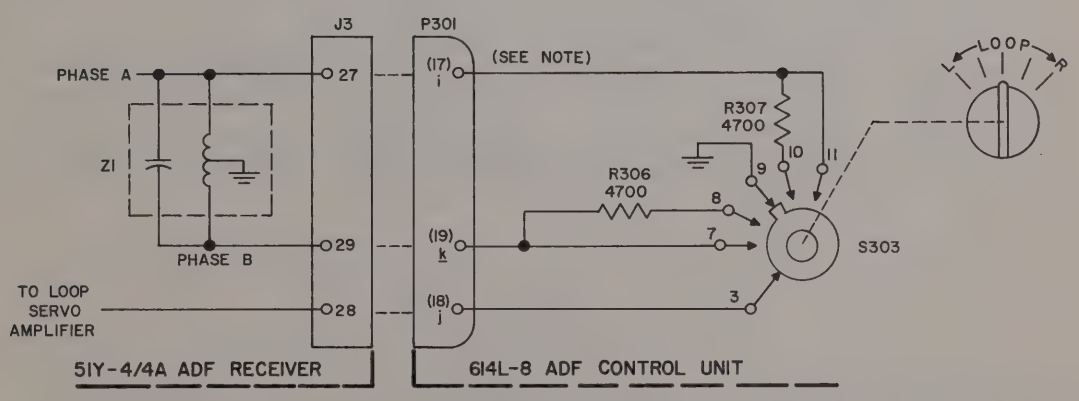
The DF-203 ADF System employs a fixed loop antenna and a goniometer rather than the conventional rotating loop antenna. The goniometer is a servo-driven resolver within



Audio Gain Circuit, Simplified Schematic Diagram
Figure 9

the 51Y-4/4A ADF Receiver and is discussed in the 51Y-4/4A overhaul manual, Collins part number 523-0755938. The goniometer armature may be rotated from the 614L-8 by the manually controlled circuit shown in figure 10. Manually controlled rotation is used in the LOOP mode for obtaining bearings and diminishing mutual interference of radio stations. In the ADF mode, manual loop rotation provides the DF-203 operator with a quality check of bearing information. This is done by observing the precision with which a bearing indication can be reestablished after the goniometer armature has been rotated past the null position.

Two phases of a 110-cps signal from the 51Y-4/4A are applied to pins i (17) and k (19) of P301 on the 614L-8. Application of either of these phases to the 51Y-4/4A loop servoamplifier will cause the servomotor to rotate the goniometer armature. Phase A causes a clockwise rotation; phase B, counterclockwise. Phase A is applied to the 51Y-4/4A loop servoamplifier by rotating S303 of the 614L-8 so that the rotor connects contacts 1 and 11. Phase B is applied by positioning S303 rotor so that contacts 1 and 7 are connected. Resistors R306 and R307, in series with S303 contacts 8 and 10 respectively, provide a diminished rate of rotation when the rotor is positioned to either of these contacts. When manually controlled loop rotation is not desired, the spring-loaded LOOP switch is positioned so that contacts 1 and 9 are connected. This grounds the manual rotation input of the loop servoamplifier, preventing spurious signals from causing unwanted rotation of the goniometer armature and allowing normal ADF operation. When contact 1 is not connected to ground through contact 9, the dc collector current path of the 51Y-4/4A servoamplifier transistor is opened thus disabling the ADF operation. This allows the manual rotation to take place in ADF mode.



NOTE:
NUMBERS IN PARENTHESIS REFER TO 614L-8 ADF CONTROL UNIT WITH COLLINS PART NUMBERS 522-2357-014, 522-2357-016, 522-2357-018.

Loop Switch Circuit, Simplified Schematic Diagram
Figure 10

(6) Tuning Meter.

The tuning meter, see figures 801, 802, and 803, is a dc ammeter with full-scale deflection current of 100 microamperes. The current applied to the meter is a rectified portion of the signal present in the if. section of the 51Y-4/4A ADF Receiver. Therefore, the current applied to the meter is proportional to the amplitude of the if. signal. The if. signal is at its greatest amplitude when the 51Y-4/4A has been accurately tuned to the selected radio station. When the meter needle is deflected as far right as possible for a given radio station, by rotating the TUNE control, the 51Y-4/4A is correctly tuned.

(7) BFO Switch.

The BFO switch, see figures 801, 802, and 803, controls the operation of the 51Y-4/4A beat-frequency oscillator. Regulated +15 volts dc from the 51Y-4/4A is supplied to the switch through pin f (14) of P301 of the 614L-8. When the BFO switch is in the BFO position, this voltage is applied to the emitter circuit of the 51Y-4/4A beat-frequency oscillator through pin F of P301. When +15 volts is applied to the emitter circuit, the transistor is properly biased and oscillation occurs. When the BFO switch is in the OFF position, no voltage is applied and the beat-frequency oscillator does not operate.

The beat-frequency oscillator (bfo) provides a tone when receiving CW signals and is used as a tuning aid.

The bfo injects a 142.5-kc signal into the 51Y-4/4A output. The result is a tone heard in the DF-203 audio output which decreases in pitch as the 51Y-4/4A is tuned to the selected radio station. Zero beat occurs when the 51Y-4/4A is correctly tuned.

(8) Tuning Circuit.

The tuning circuit is shown in figure 11. When the 614L-8 mode switch, S302B, is not in the OFF position, 26 volts, 400 cps is impressed on the rotor of synchro B301. The synchro rotor is geared to the TUNE control and the dial drum. The resultant of the currents induced in the synchro stator windings will be different for each position of the rotor. Thus, the 3-phase output of the synchro stator is applied to the 51Y-4/4A ADF Receiver which uses this information to control the position of its tuning capacitor. Operation of the 51Y-4/4A synchro control transformer and tuning servo is discussed in detail in the 51Y-4/4A overhaul manual, Collins part number 523-0755938.

614L-8 ADF Control Unit - Disassembly

1. GENERAL.

Included within this section are instructions for the disassembly of the 614L-8 ADF Control Unit. Disassembly procedures should be accomplished only when repair is required. Do not perform the disassembly procedures as a part of routine maintenance. Disassembly procedures are arranged proceeding from the highest to the lowest subassembly. The disassembly of electronic equipment can usually be accomplished by inspection. However, when required, special techniques, cautions, warnings, and unique procedures are included in this section.

CAUTION: BE SURE THAT THE POWER CABLE IS REMOVED BEFORE DISASSEMBLING ANY PORTION OF THE EQUIPMENT. FAILURE TO COMPLY MAY CAUSE VOLTAGE TRANSIENTS WHICH COULD DESTROY THE TRANSISTORS.

Disassembly of the 614L-8 ADF Control Unit requires no special tools or fixtures. Disassembly should be done in an area where parts will not be exposed to dust and grit. To aid in locating specific parts, the number designating the part in the exploded view (figure 101) is included in parentheses following the name of the part.

2. DISASSEMBLY PROCEDURE.

NOTE: If it is necessary to unsolder any connections, a note should be made of the original destination of each wire removed.

A. Removal of Front Plates.

(1) Loosen setscrews securing control knobs to control shafts. Remove knobs.

(2) Remove screws (21, 22) and remove front panel (24/25) from front of 614L-8.

(3) Remove panel light assembly (27/30) far enough to permit terminal leads (29) to be unsoldered. Unsolder these leads.

(4) Remove nut (part of 31) and lockwasher (32) securing toggle switch (31) to subpanel (35/42).

(5) Loosen two Dzus fasteners located on rear cover (1/4). Slide rear cover (1/4) off unit.

(6) Remove four screws (36), and four lockwashers (37) securing subpanel (35/42). Slide subpanel (35/42) over control shafts exercising care that leads to meter (33) are not damaged.

(7) Remove two screws (34) securing meter (33) to subpanel (35/42). It is not necessary to remove meter leads unless meter is to be replaced.

B. Removal of Attenuator.

(1) Loosen two setscrews (68), remove crown gear (67) from attenuator shaft (69).

(2) Remove nut (70) and lockwasher (71) from attenuator (69), and remove attenuator (69) from casting (188/201).

C. Removal of OFF/ADF/ANT/LOOP Switch.

(1) Remove retaining ring (74) from gain control shaft assembly (76). Remove gain control shaft assembly (76) from casting (188/201).

(2) Remove spring (65) from grooved pin (193).

(3) Remove detent follower (66) from detent holder (189).

(4) Remove mode-switch shaft assembly (77) from front of casting (188/201).

(5) Remove switch wafer (80, 82). Do not remove leads except to replace wafers.

D. Removal of LOOP Switch.

(1) Remove nut (48) and lockwasher (49) from LOOP switch (47).

(2) Remove LOOP switch (47) from casting (188/201).

(3) Remove two nuts (51), and remove resistor board (50/59) from LOOP switch (47). Do not remove leads except to replace LOOP switch.

E. Removal of Tuning Gear Train.

(1) Remove three screws (102) and three lockwashers (103) securing retaining plate (101/106) to casting (188/201).

(2) Remove fixed resistor (91) from retaining plate (101/106) by removing screw (94).

(3) Remove four screws and nuts securing retaining plate (101/106) to connector (87).

(4) Loosen two setscrews in collar (149) and remove spur gear (151) from shouldered shaft (165).

(5) Loosen two setscrews in collar (152), and remove spur gear (154) from shouldered shaft (165).

NOTE: Number of washers (155) may be less than shown. Record number for reassembly.

(6) Remove shaft and gear assembly (163/165) from frame (188/201).

(7) Loosen four setscrews in collars (125, 132) and withdraw tuning control shaft from rear of frame (188/201).

(8) Remove worm gear (131) and collars (125, 132) from frame (188/201).

F. Removal of Dial Drum.

(1) Loosen four setscrews in collars (175, 138/135).

(2) Remove gear and shaft assembly (179, 181, 182/184, 183) from top of frame (188/201).

(3) Remove two screws (44), two lockwashers (45), two flatwashers (46), and remove dial mask (43) from frame (188/201).

(4) Remove dial drum (186) from frame (188/201) ensuring that spring (185) is not distorted.

(5) Remove collar (175) from frame (188/201).

G. Removal of Synchro Transmitter.

(1) Insert no. 4 Bristol wrench through notch in rear of frame (188/201) at top of synchro, and loosen two setscrews (167).

(2) Remove spur gear (168) from top of synchro (174).

(3) Loosen three screws (172) at top of synchro (174).

(4) Orient three rim-clenching clamps (171) to permit removal of synchro (174), and remove synchro (174).

H. Removal of Band Switch.

(1) Remove collar (138/135) from band-switch shaft assembly (145). Two setscrews (136) in collar (138/135) were loosened in step F.(1).

(2) Remove spring (143) from grooved pin (193).

(3) Remove detent follower (144) from pin (189).

(4) Remove dial drum lever (142) from frame (188/201).

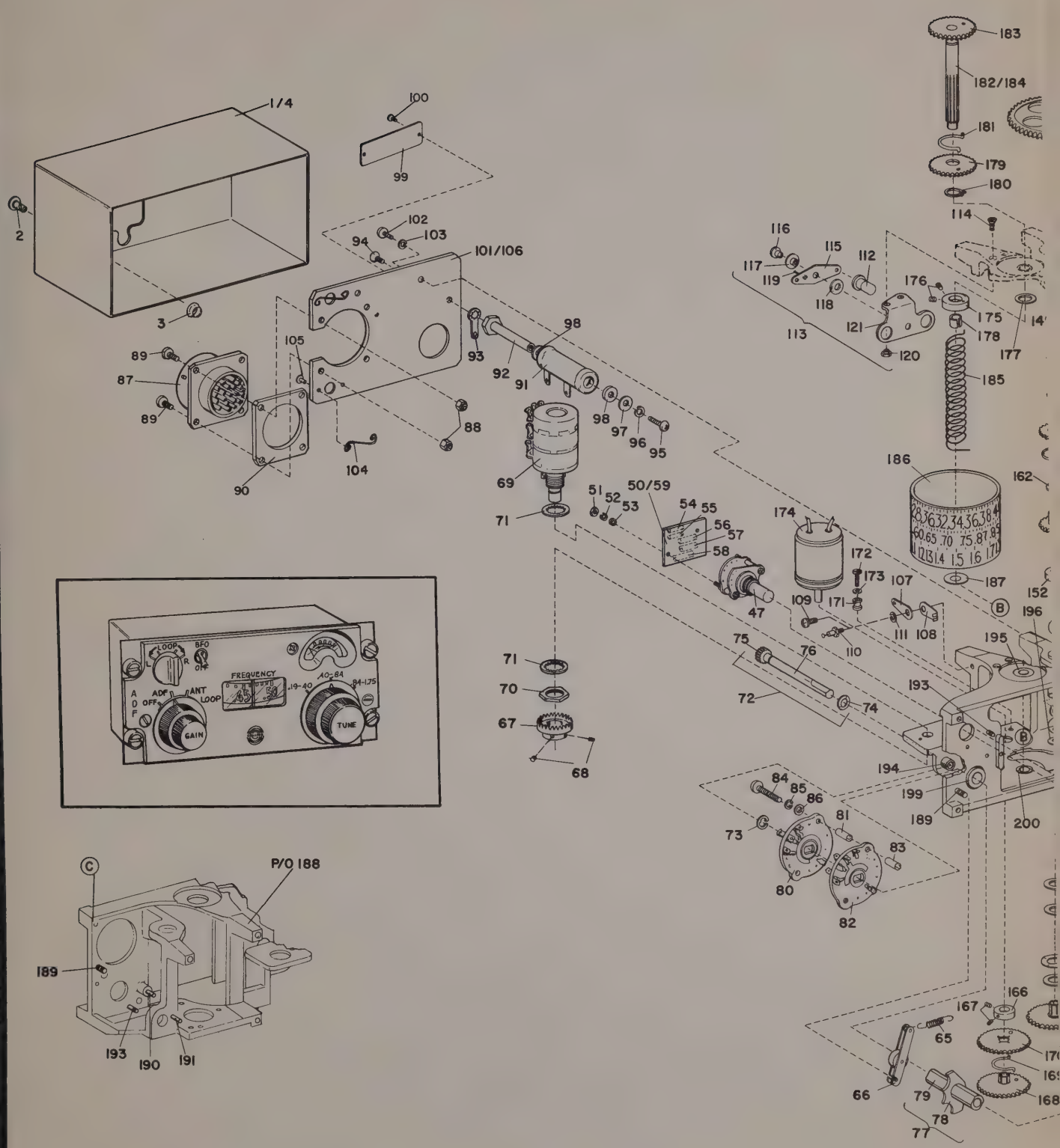
(5) Withdraw wheel detent assembly (146) from rear of frame (188/201).

(6) Remove two screws (62), two nonmetallic washers (63), and two lockwashers (64). Do not disconnect band-switch leads (60) unless switch is to be replaced.

I. Removal of Lampholder.

(1) Remove two screws (114), and remove lampholder (113) from frame (118/201).

(2) Two lamps (112) are removed from holder (113) by rotating clamp (115) around shouldered washer (118).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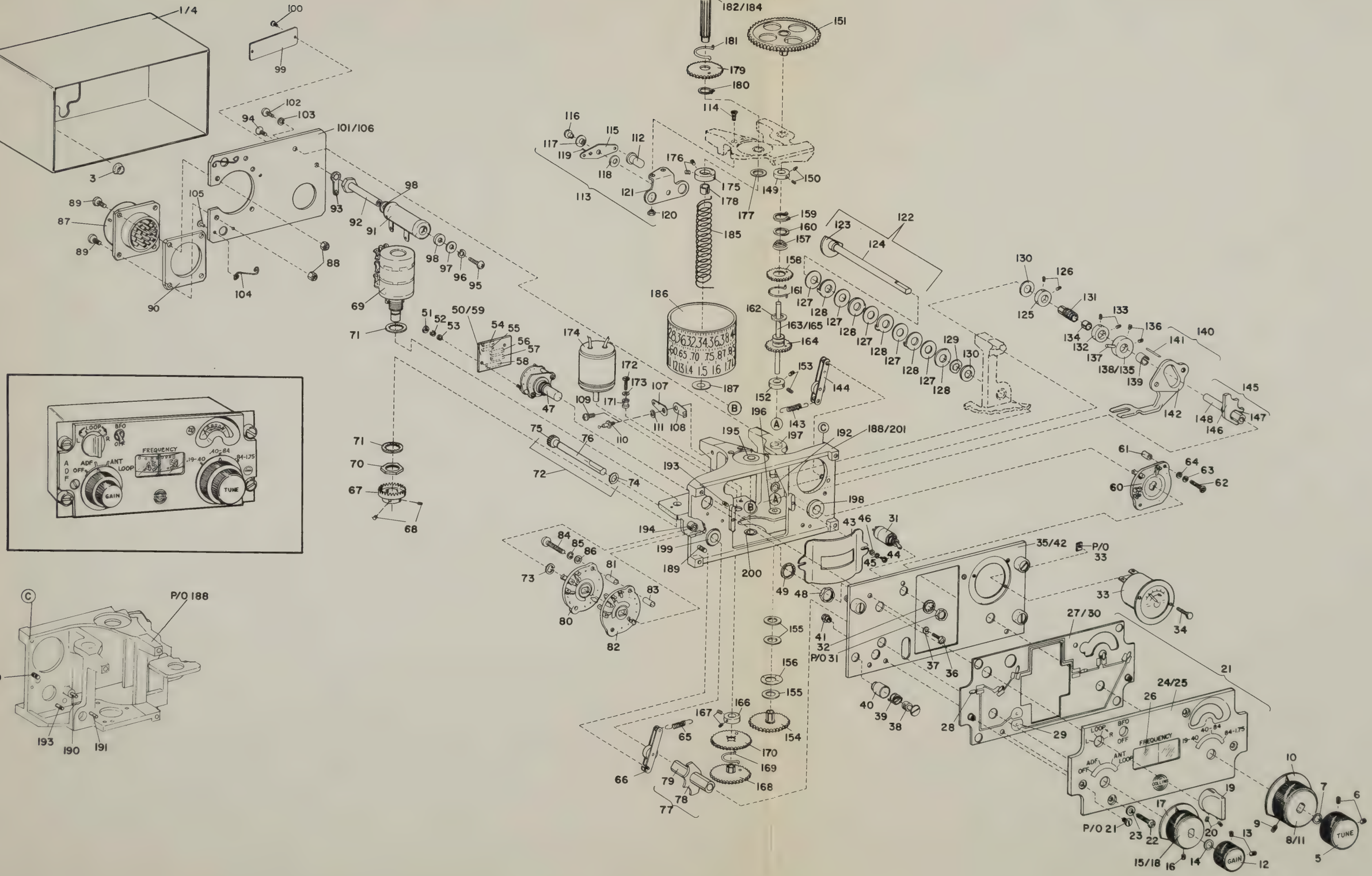
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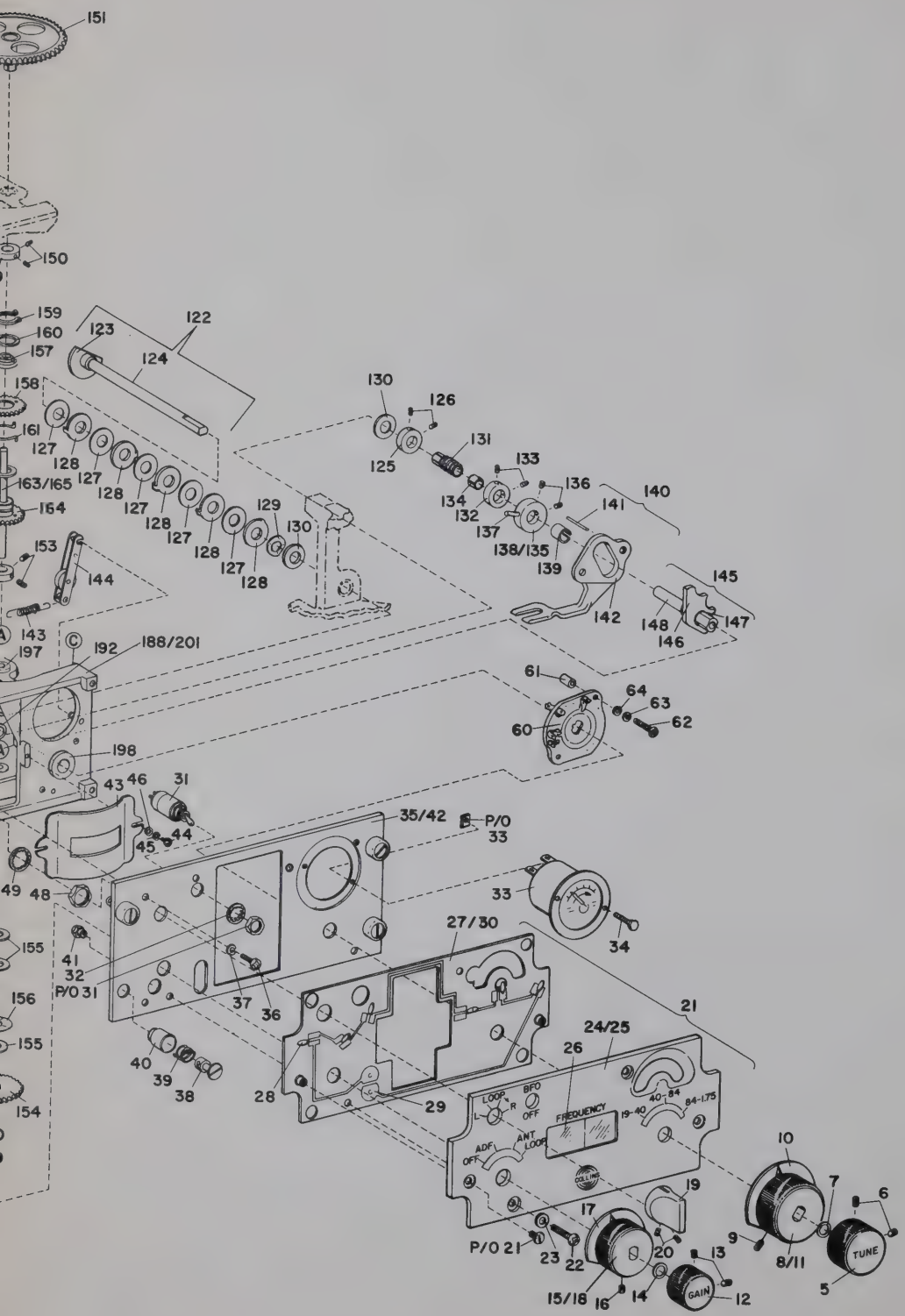
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44
45
49
48
155
41
32
P/O 31
156
155
154
40
39
38
37
36
28
29
35/42
P/O 33
33
34
27/30
21
24/25
26
LOOP
L
R
BFO
OFF
FREQUENCY
ADF
OFF
ANT
LOOP
19-40
40-84
84-175
19
17
P/O 21
23
22
15/18
16
14
20
13
12
GAIN
9
8/11
10
7
6
TUNE
5
122
123
124
130
126
125
131
133
134
132
136
137
138/135
139
140
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142
145
148
146
147
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129
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614L-8 ADF Control Unit - Cleaning

1. GENERAL.

Included within this section are instructions for cleaning dismantled and disassembled components, subassemblies, and parts of the 614L-8 ADF Control Unit.

Instructions are arranged in tabular form to facilitate reference by paragraph to the procedure for cleaning the various parts and assemblies. All parts requiring special methods of cleaning are considered separately, and parts which are similar enough to permit identical cleaning procedures are grouped. The composition of solvent referenced in the following procedures is shown in figure 201. Figure 201 also lists other cleaning materials used on the 614L-8.

WARNING: PERFORM OPERATION INVOLVING CLEANING SOLVENT UNDER A VENTILATED HOOD. AVOID BREATHING SOLVENT VAPOR AND FUMES; WEAR A SUITABLE MASK WHEN NECESSARY. AVOID CONTINUOUS CONTACT WITH THE SOLVENT. USE GOGGLES, GLOVES, AND APRON TO PREVENT IRRITATION DUE TO PROLONGED CONTACT. CHANGE CLOTHING THAT HAS BECOME SATURATED WITH SOLVENTS. OBSERVE ALL FIRE PRECAUTIONS FOR FLAMMABLE MATERIALS. THESE MATERIALS SHOULD BE USED IN A HOOD PROVIDED WITH EXPLOSION-PROOF ELECTRICAL EQUIPMENT AND AN EXHAUST FAN WITH SPARKPROOF BLADES. OTHER PERSONS SHOULD BE WARNED TO KEEP AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

References to air jet in this section indicate a hand-operated air nozzle supplied with clean and dry compressed air at a pressure of 28 pounds per square inch maximum.

WARNING: GOGGLES SHOULD BE WORN WHEN USING THE AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT PARTS. OTHER PERSONS SHOULD BE WARNED TO KEEP AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

MATERIAL	RECOMMENDED TYPE
Solvent	Methylene chloride 25 percent (by volume), perchloroethylene 5 percent dry cleaning solvent, Fed Spec P-S 661a or equivalent, 75 percent
Cloth, lintless cotton	
Detergent	Commercial powder containing no bleach
Paper, lens tissue	
Paper, fine grade tissue	

Table of Cleaning Material
Figure 201

2. CLEANING PROCEDURES.

The following paragraphs provide instructions and procedures for cleaning the various parts of the dismantled and disassembled equipment preparatory to the inspection procedures. Figure 202 lists an index of cleaning procedures. A paragraph containing the correct procedure is referenced opposite each part to be cleaned. Refer to figure 202.

ITEM	REFER TO PARAGRAPH
Casting	A
Chassis, wired	B
Connectors	C
Covers	D
Dials and knobs	E
Gears, metal and fiber	F
Machined metal parts	G
Molded plastic parts	H
Plastic panel and dial drum	I
Rotary switch	J
Toggle switch	K

Index of Cleaning Procedures
Figure 202

A. Castings.

Blow dust from surfaces, holes, and recesses with air jet. Remove deposits from bearings with solvent-moistened rag.

CAUTION: DO NOT SOAK CONTROL BOX CASTING IN SOLVENT. SOLVENT WILL IMPAIR LUBRICANT IMPREGNATION OF OILITE BEARINGS IN CASTING.

B. Chassis, Wired.

The following cleaning procedures should be used for chassis containing terminal boards, and other wired parts.

(1) Remove dust and dirt from all surfaces, including parts and wiring, using soft-bristled brushes in conjunction with air jet.

CAUTION: AVOID AIR BLASTING SMALL COILS, LEADS, AND OTHER DELICATE PARTS BY TOO CLOSE AN APPROACH WITH AIR JET NOZZLE. USE CAUTION IN USE OF BRUSHES ON DELICATE PARTS.

NOTE: When necessary to disturb the dress of wiring and cables, dressing should be noted, and wiring and cables restored to positions and dress after cleaning is completed.

C. Connectors.

(1) Wipe dust and dirt from bodies, shells, and cable clamps using solvent-moistened, lintless cloth. Wipe dry with a clean, dry, lintless cloth.

(2) Remove dust from inserts using a small soft-bristled brush and air jet.

(3) Wash dirt and any traces of lubricant from inserts, insulation, and contacts using a solvent applied sparingly with a small camel-hair brush.

CAUTION: DO NOT ALLOW SOLVENT TO RUN INTO SLEEVES OR CONDUIT COVERING ANY WIRES OR CABLES CONNECTED TO CONTACT TERMINALS OF THE INSERT.

(4) Dry insert with air jet.

D. Covers.

(1) Remove grease with a cloth and solvent mixture.

(2) Blow dust from surfaces, holes, and recesses using air jet.

E. Dials and Knobs.

Clean dials and knobs by gently wiping their surfaces with clean, soft, lintless cloth which has been slightly moistened with solvent.

F. Gears, Metal and Fiber.

If gear trains are disassembled for replacement or defective gears, the gears should be cleaned according to the following procedures:

(1) Metal gears should be cleaned by removing dust from exteriors with a camel-hair brush and air jet.

(2) Composition or plasticized gears and nylon friction clutches should be cleaned by removing all surface dust and dirt using soft-bristled brush in conjunction with air jet. Using a clean, lintless cloth lightly moistened with solvent, clean composition gears by wiping clean.

CAUTION: SOLVENT SHOULD NOT BE USED TO CLEAN GEARS COMPOSED OF OR CONTAINING NYLON. CLEAN THESE GEARS USING A WASHING BATH OF 2 OUNCES OF DETERGENT POWDER TO A GALLON OF WATER AND USING SUITABLE BRUSHES TO REMOVE SURFACE DIRT OR FOREIGN MATTER. GEARS COMPOSED OF EPOXY AND SUPPORTING BASE MATERIAL ARE SUSCEPTIBLE TO SOFTENING IF SOLVENT IS APPLIED FOR EXCESSIVE PERIODS OF TIME OR IF EXCESSIVE AMOUNTS OF SOLVENT ARE USED. USE CARE IN CLEANING THESE GEARS WITH SOLVENT, AND DRY WITH CLEAN, LINTLESS CLOTH.

G. Machined Metal Parts.

Detached shafts, keys, pins, collars, worms, springs, and similar machined parts should be cleaned in a suitable cleaning machine, if available; otherwise, proceed as follows:

(1) Remove bulk of surface grease with rags.

(2) Immerse metal parts in washing bath of solvent and scrub until clean working over all surfaces and into all holes and recesses with a suitable nonmetallic brush. Flat, wood-backed brushes with soft-fiber bristles are recommended for surfaces; round brushes, similar to those used for washing bottles and test tubes, are recommended for holes and recesses.

(3) Raise metal parts from bath, and permit solvent to drain into bath.

(4) Immerse in rinsing bath of cleaning solvent, rinse, and raise from bath. Position casting to drain dry so that solvent is not trapped in holes or recesses. When practical positioning will not permit complete draining, use air jet to blow out any trapped solvent.

CAUTION: TO PREVENT CORROSION, AVOID TOUCHING WITH BARE HANDS ANY MACHINED OR NONFINISHED SURFACES AFTER CLEANING.

(5) Dry in dust-free, dry area or suitable enclosure. Radiant head used in a ventilated enclosure is recommended for drying, particularly where atmospheric humidity is high.

(6) When dry, immediately apply a light coat of MIK-L-7870 lubricating oil to any bare steel surfaces.

H. Molded Plastic Parts.

Plastic parts include insulating members, terminal boards, mounting blocks, etc. These should be cleaned in the following manner.

(1) Using an air jet, blow loose dust and dirt from surfaces, holes, and crevices.

(2) Wipe clean using a solvent-moistened, lintless cloth.

(3) Dry and polish with a clean, dry, lintless cloth.

I. Plastic Panel and Dial Drum.

Clean plastic panel and dial drum with a soft cotton cloth and a soap or mild detergent solution.

J. Rotary Switches.

(1) Remove all dust with air jet, turning switch rotor back and forth several times while applying air jet.

(2) Wash all contacts and insulation with solvent lightly applied with small camel-hair brush.

(3) Dry with air jet, then repeat wash using clean solvent, rotating switch rotor several times during this wash.

(4) Dry gently but thoroughly with air jet.

K. Toggle Switch.

(1) Using air jet, blow dust from surfaces and crevices of switch body.

(2) Wipe with solvent-moistened, lintless cloth, and dry with air jet.

614L-8 ADF Control Unit - Inspection/Check

1. GENERAL.

Included within this section are instructions necessary to verify, by inspection, the condition of disassembled and cleaned assemblies of the 614L-8. Inspection will reveal defects that result from wear, physical damage, deterioration, or other causes. Detailed inspection procedures are arranged alphabetically. Wear tolerances are listed in the fits and clearances section of this manual where applicable. Refer to the repair section of this manual for replacement of defective components.

2. INSPECTION PROCEDURES.

Figure 301 lists mechanical and electrical parts to be inspected and contains references to applicable paragraphs.

REFERENCE	PARAGRAPH
Castings	A
Chassis	B
Connectors	C
Covers	D
Gears, metal and fiber	E
Machined metal parts	F
Molded plastic parts	G
Printed circuit boards	H
Resistors	I
Rotary switches	J
Soldered terminal connections	K
Toggle switch	L
Wiring	M

Index of Inspection Procedures
Figure 301

A. Castings.

Inspect castings for cracks or breaks and marred or damaged machined surfaces, holes, counterbores, or threads. Determine whether finish requires touchup repairs. Examine bushings and tapped holes for signs of wear and mechanical distortion.

B. Chassis.

Inspect chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors, damaged fastener devices, or damaged handles. Inspect for corrosion and damage to finish that requires work in finishing department.

C. Connectors.

Inspect connector bodies for broken parts, deformed shells or clamps, and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed, or out of alignment. Inspect for corroded or damaged plating on contacts and for loose, poorly soldered, broken, or corroded terminal connections.

D. Covers and Shields.

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Inspect for damaged fastener devices, corrosions, and damage to finish that requires work in finishing department.

E. Gears, Metal and Fiber.

Inspect gears for broken, chipped, or badly worn teeth. Inspect gear bodies for cracks and deformation. Inspect surfaces for corrosion or other abnormal conditions.

F. Machined Metal Parts.

Inspect for physical damage to surfaces, corners, and edges. Inspect closely all machined surfaces, holes, bores, counterbores, slots, grooves, shoulders, flanges, teeth, tapped holes, and all threaded members, both male and female, for physical damage of any sort including roughness of surface, corrosion, or presence of foreign matter. Inspect plated or finished areas for damage requiring replating or refinishing beyond touchup repair.

G. Molded Plastic Parts.

Inpsect plastic parts, such as terminal boards, mounting blocks, and insulating members, for signs of corrosion, cracked or charred insulation, and loose or missing mounting hardware. Inspect for other abnormal indications which might be a source of future breakdown.

H. Printed Circuit Boards.

Inspect printed circuit boards for loose, broken, corroded, or poorly soldered terminal connections. Inspect printed circuits for any evidence of damage, such as burned, broken, cracked, or corroded plating. Inspect for loose mounting of printed circuit boards.

I. Resistors.

Inspect fixed composition resistors for cracked, broken, blistered, or charred bodies and loose, broken, poorly soldered, or corroded terminal connections.

Inspect fixed wire-wound resistors for signs of heating; cracked, broken, or charred insulation; loose, poorly soldered, broken, or corroded terminal connections; and loose mounting.

J. Rotary Switches.

Inspect switch wafers for bent, weak, broken, or deformed contacts. Inspect for corrosion, damage to contact plating, and cracked or broken contact insulation. Check to see that movable contacts are free to rotate properly without binding throughout entire excursion. Inspect components mounted on switch wafers for physical damage.

K. Soldered Terminal Connections.

Inspect soldered terminal connections for cold-soldered or resin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using the point of a tool. Examine for excess of solder; protrusions from the joint; pieces adhering to adjacent insulation; and particles lodged between joints, conductor, or other parts. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor at joint. Also, look for insulation that is stripped back too far from joint or badly frayed at joint. Inspect for corrosion (verdigris) on copper conductor at the joint.

L. Toggle Switch.

Inspect this switch for rough or loose action, cracked, or charred body, loose, poorly soldered, or corroded terminals.

M. Wiring.

Inspect open and laced wiring of chassis, terminal boards, and parts of equipment by checking insulation for physical damage and charring. Inspect wires for breakage and for improper dress in relation to adjacent wiring and chassis.

614L-8 ADF Control Unit - Repair

1. GENERAL.

Included within this section are instructions for the replacement or repair of damaged or defective components of the 614L-8. Faulty components usually are detected through procedures in the inspection or testing section of this manual. If a new part is to be installed, it should first be inspected and tested.

Most of the repair or replacement instructions apply to disassembled equipment. Refer to the disassembly section for proper instructions.

2. REPAIR PROCEDURES.

The following paragraphs provide instructions and procedures for repairing components of the equipment. Figure 401 lists an index of repair procedures, and contains references to applicable paragraphs.

REFERENCE	PARAGRAPH
Bearings	A
Connectors	B
Covers	C
Frame	D
Gears, metal and fiber	E
Resistors	F
Soldered terminal connections	G
Switches	H
Wiring	I

Index of Repair Procedures
Figure 401

A. Bearings.

Shielded bearings will rarely need lubrication. If found defective, replacement with another bearing, new or known to be good, is advised.

B. Connectors.

Straighten bent pins and damaged shell areas. Replace bad connections, broken wires, or wires with split insulation. If connector insert is broken, replace connector.

C. Covers.

Replace damaged screws, straighten any dents or warped sections, and retouch scratched worn painted surfaces.

D. Frame.

Straighten misshapen areas. Remove all corrosion with a suitable cleaner. Retouch silk screening, and refinish where needed.

E. Gears, Metal and Fiber.

Metal or fiber gears should be replaced if found defective in inspection or testing sections. Instructions are given in assembly and disassembly sections of this manual.

F. Resistors.

Replace defective resistors with components known to be good, and carefully resolder bad connections.

G. Soldered Terminal Connections.

Resolder cold-solder or resin joints. Remove all traces of corrosion.

H. Switches.

Switches are usually replaced and seldom repaired. Wafers in wafer-type switches may be replaced separately and so may defective pins in the crimped-pin type of connector. Leads should be properly identified to simplify rewiring.

I. Wiring.

Replace damaged wiring with wire of same size and color coding. Ensure that no bare wires are touching chassis, other bare wires, or metal cases of other parts.

If any wire is to be removed from a terminal or component, it should be marked with an identification tag to minimize incorrect connections.

NOTE: When necessary to disturb the dress of the wires, carefully ensure that the original wire dress is maintained when replacing wires.

614L-8 ADF Control Unit - Assembly

1. GENERAL.

Included within this section are assembly instructions and mechanical alignment procedures for the 614L-8 ADF Control Unit. No special tools or fixtures are required to carry out either of these procedures. To ensure correct assembly, frequent reference should be made to figure 101. The number assigned to each part shown in figure 101 appears in parentheses following references to the part in the text of this section. Fits and clearances for assembly tolerances along with the lubrication procedures are included in this section.

2. LUBRICATION PRIOR TO ASSEMBLY.

Apply a small quantity of lubricating oil, MIL-L-7870, Collins part number 005-0116-00, to both the inner and thrust surfaces of each bearing of frame (188/201). Do not allow excess oil to reach other parts of the casting.

3. ASSEMBLY.

A. Replacement of Lampholder.

(1) Place lamp (122) in lampholder (113) and secure with clamp (115).

(2) Use screws (114) to secure lampholder to frame (188/201) immediately behind bearing (195).

(3) Use screw (109) and lockwasher (111) to secure wire clamp (108) and terminal lug (107) to frame (188/201).

B. Replacement of Band Switch.

(1) Orient switch wafer (60) so the X mark near securing hole is toward rear of frame (188/201) and to right as seen from the front.

(2) Insert two screws (62) with two fiber washers (63) and two lockwashers (64) through switch wafer (60) and two spacer sleeves (61) at both ends of switch. Tighten screws in frame holes.

(3) If contacts of switch are not wired, connection should now be made after wires are passed through unfinished hole in frame (188/201) adjacent to switch wafer (60).

(4) Place notched end of band detent follower (144) on grooved pin (189) with notch opening near edge of frame (188/201). Band detent follower (144) differs from mode detent follower (66) in that the detent wheel of the band detent follower (144) is placed in the retaining holes nearest the fastening rivet at the end of the follower.

(5) Insert band-switch shaft assembly (145) through rear of bearing (198).

(6) Connect spring (143) between riveted end of band detent follower (144) and grooved pin (193) on frame (188/201).

C. Replacement of TUNE Shaft and Worm Gear.

(1) Alternately place the five stopwashers (128) and the five flat washers (127) on the tuning shaft assembly (122). When these are in place, place spring washer (129) and flat washer (130) on the shaft.

(2) Apply a small quantity of lubricant, MIL-L-7870, Collins part number 005-0116-00, to each of the five flat washers (127).

(3) Insert tuning shaft assembly (122) through rear of bearing (192) allowing about one-half inch to protrude beyond front of bearing (192).

(4) Place dial drum lever (142) on pin (190) oriented so pin (141) protrudes toward rear of frame (188/201). The rear end of band-switch shaft assembly (145) should protrude through the closed slot in the body of the dial drum lever (142).

(5) Insert split sleeve bearing (139) into lift shaft collar (138/135). Place both on band-switch shaft assembly protruding through the closed slot in the dial drum lever (142). Pin of lift shaft collar (138/135) should be toward right side of frame (188/201): two setscrews (136) should be oriented down and to the left, not up and to the right. Do not tighten setscrews (136) in collar (138/135).

(6) Place flat washer (130), collar (125), and worm gear (131) with shank toward rear of frame (188/201), and bearing sleeve (134), and collar (132) on tuning shaft assembly (124) protruding through front of bearing (192).

(7) Continue to insert tuning shaft assembly (122) through bearing (192) until it is seated.

(8) Hold collar (125) and worm gear (131) against bearing (192). Tighten two setscrews (126).

(9) Slide collar (132) and bearing (134) forward until they meet the end of the band-switch assembly (145). Tighten two setscrews (133).

D. Replacement of Synchro.

(1) Use three screws (172) and three lockwashers (173) to loosely secure three rim-clenching clamps (171) to frame (188/201).

(2) Use three clenching clamps (171) to secure synchro (174) to frame (188/201) in orientation suitable for lead length.

(3) Tighten three screws (172).

E. Replacement of Gear Train.

(1) Place collar (152) on lower section of shaft (163/165).

(2) Place collar (149) on upper section of shaft (163/165).

(3) Place shaft (163/165) with collars (152/149) between bearings (196/197). Bearings (196/197) are located forward and to the right of synchro (174) as seen from the front of the frame (188/201). The shorter section of the shaft (163/165) should be down.

(4) Place three flat washers (155) and spring washer (156) on spur gear (154), in order given.

(5) Insert hub of spur gear (154) through bottom of bearing (196) containing gear and shaft (163/165).

(6) Insert lower section of shouldered shaft (165) into hub (154). Place collar (152) on spur gear (154).

(7) With end of shouldered shaft (165) flush with bottom of recess in spur gear (154), tighten collar (152).

(8) Insert hub of spur gear (151) through top of bearing (197) containing upper section of shouldered shaft (165). Shouldered shaft (165) should be inserted into hub spur and gear (151).

(9) Move gear (151) and shouldered shaft (165) down until collar (152) rests against lower bearing (196).

(10) With only upper half of helical gear (158) and of gear and shaft (163/165) engaged with worm gear (131), rotate spur gear (154) clockwise as seen from the bottom of frame (188/201).

(11) Rotate spur gear (154) clockwise approximately 8 teeth. Check that enough torque is applied to spur gear (154) to cause rotation if released. If torque is not sufficient, continue to revolve spur gear (154) clockwise as seen from bottom of frame (188/201).

(12) Move gear and shaft (163/165) upward until both halves of helical gears (158, 164) are engaged with worm gear (131), and upper end of shaft (163/165) is flush with bottom of recess in top of spur gear (151). Hold in this position.

(13) Place collar (149) on hub of spur gear (151), and tighten two setscrews (150). Release spur gear (151).

F. Replacement of Dial Drum.

(1) Rotate tuning shaft assembly (122) fully clockwise.

(2) Place spring (169) between spur gears (168, 170). Insert shank of spur gear (168) into collar (166). Tighten two setscrews (167) only as much as necessary to retain collar (166) on shank of spur gear (168).

(3) Place spring (181) between spur gear (183) and spur gear (179).

(4) Ends of spring (181) must be in retaining holes in spur gears (183, 179).

(5) Press retaining ring (180) into slot on straight shaft (184).

(6) Insert gear and shaft (182) through top of bearing (195) at top center of frame (188/201). Allow about one-half inch of straight shaft (184) to extend through bearing (195).

(7) Place collar (175) containing bearing (178) on straight shaft (184) extending through bearing (195).

(8) Place spring (185) on straight shaft (184) with hooked end in hole in collar (175).

(9) Lower dial drum lever (142) to bottom of frame (188/201).

(10) Place dial drum (186) under end of straight shaft (184).

(11) Place lower end of spring (183) over center post of dial drum (186).

(12) Insert straight shaft (184) into dial drum (186). Allow straight shaft (184) to protrude about 1/4 inch through bottom of dial drum (186).

(13) Place flat washer (187) on straight shaft (184) under dial drum (186).

(14) Rotate lift shaft collar (138/135) until dial drum lever (142) raises dial drum (186) to approximately 1/4 inch of top of frame (188/201).

(15) Tighten one screw (136) to secure left shaft collar (138/135). Lower shaft (182/184) until spur gear (179) only engages spur gear (151).

(16) Rotate dial drum (186) until spur gear (183) has revolved approximately eleven teeth. Torque on dial drum (186) should be sufficient to cause rotation if dial drum (186) is released.

(17) Lower spur gear (183) until it meshes with spur gear (151).

(18) Revolve collar (175) approximately one turn to apply torque to spring (185). Tighten two setscrews (176).

G. Replacement of OFF/ADF/ANT/LOOP Switch.

(1) Orient the first wafer (82) so that the X mark is facing front and is on top. The dimple in the shaft slot should be at the left, as seen from the front.

(2) Orient the second wafer (80) as the first wafer (82) was oriented. The dimple in the shaft slot should be to the left as seen from the front.

(3) Use four spacers (81/83) to separate switch wafers (80, 82) from each other and from frame (188/201).

(4) Use two screws (84), two lockwashers (85), and two flat washers (86) to secure switch wafers (80, 82) and spacers (81/83) to frame (188/201).

(5) Insert mode switch shaft assembly (77) through front of bearing (199) and through switch wafers (80, 82). Section of shaft (77) with incomplete flats faces rear. The shaft (77) must be fully seated against the Oilite bearing (199).

(6) Place notch of detent follower (66) on grooved pin (189) with notch opening facing left, as seen from the front.

(7) Connect spring (65) between rivet of detent follower (66) and grooved pin (193).

H. Replacement of LOOP Switch.

(1) If LOOP switch (47) is not wired, connect leads before proceeding further.

(2) Insert shank of LOOP switch (47) into hole in upper left corner of frame (188/201).

(3) Secure LOOP switch (47) with nut (48) and lockwasher (49).

(4) Use two nuts (51), two lockwashers (52), and two flat washers (53) to secure resistor board (50/59) to rear of LOOP switch (47). Orient resistor board (50/59) so 33,000-ohm resistor is on top.

I. Replacement of Synchro Spur Gear.

(1) Rotate dial drum (186) until 1.4-mc mark faces forward. It may be necessary to loosen worm gear (131) on shoulder shaft (148) to do this.

(2) Place shank of spur gear (168) on synchro (174) shaft. Do not mesh spur gears (168, 170) with spur gear (154).

(3) Lower spur gear (168) until spur gear (170) is meshed with spur gear (154).

(4) Rotate spur gear (168) clockwise, as seen from the bottom of the frame, approximately 10 teeth.

(5) Check that torque applied to spur gear (168) is sufficient to cause rotation if spur gear (168) were released.

(6) Without releasing torque on spur gear (168), lower spur gear (168) until it is meshed with spur gear (154).

(7) Tighten one setscrew (167) appearing at access notch. Do not tighten remaining setscrew (167) until alignment procedures at end of this section are performed.

J. Replacement of Attenuator.

(1) Place spring washer (73) on gain shaft assembly (72).

(2) Insert gain shaft assembly (72) through rear of bearing (194).

(3) Place retaining ring (74) in slot on gain shaft assembly (72).

(4) If attenuator (69) is not connected to leads, make connection.

(5) Mount attenuator (69) using nut (70) and one spring washer (71) on each side of frame (188/201).

(6) Place crown gear (67) on attenuator shaft (69) so crown gear (67) meshes with spur gear (75).

(7) Tighten two setscrews (68).

K. Replacement of Rear Retaining Plate.

(1) Fasten connector (87) to rear retaining plate (101/106) using four screws (89) and four lock nuts (88).

(2) Fasten fixed resistor (91) to retaining plate (101/106) using screw (94).

(3) Secure retaining plate (101/106) to frame (188/201) using three screws (102) and three lockwashers (103). Exercise care to avoid pinching or straining leads.

L. Replacement of Front Plates and Control Knobs.

(1) Secure the dial mask (43) to the front of frame (188/201) using two screws (44), two lockwashers (45), and two flat washers (46). Check that dial mask (43) does not touch the drum dial (186).

(2) Fasten meter (33) to front subpanel (35/42) using two screws (34) and two nuts (part of 33).

(3) Place subpanel (35/42) over control shafts (47, 79, 148). Insert toggle switch (31) through hole in subpanel (35/42). Secure toggle switch (31) to subpanel (35/42) using nut (part of 31) and lockwasher (32).

(4) Pass panel lamp assembly leads (27) through unfinished hole in lower front edge of frame (188/201). Pass leads through slot in subpanel (35/42).

(5) Fasten subpanel (35/42) to the frame using four screws (36) and four lockwashers (37).

(6) Solder panel lamp (27) leads to terminals (29) of panel lamp assembly (27/30).

(7) Fasten panel lamp assembly (27/30) to front panel (24/25) using two screws (part of 21).

(8) Center front panel (24/25) on unit, and secure to frame using two screws (22) and two lockwashers (23). Place mode knob (15/18) on mode shaft (77) leaving a small gap between knob and panel. Make certain the shaft (77) is fully seated against the Oilite bearing (199). Tighten setscrew (16).

(9) Place band-switch knob assembly (8/11) on band-switch shaft (147) leaving small gap between band knob (11) and panel (24/25). Tighten setscrew (9).

(10) Place washer (14) and GAIN knob (12) on attenuator control shaft assembly (76) leaving 0.006 ±0.004-inch clearance between knobs (12) and (15/18), in addition to clearance caused by washer (14). Tighten two setscrews (13).

(11) Place washer (7) and TUNE knob (5) on tuning shaft (124). Tighten two setscrews (6).

(12) Place LOOP knob (19) on loop switch shaft (47) leaving small gap between LOOP knob (19) and panel (24/25). Tighten two setscrews (20).

4. LUBRICATION AFTER ASSEMBLY.

Apply several drops of gear lubricant, Collins part number 005-0732-00, to worm gear (131). Rotate TUNE control several turns after application to spread lubricant over entire gear.

The composition of the gear lubricant is given in figure 501.

PARTS BY WEIGHT	COMPONENT
25	Beacon 325 grease
37	Butyl alcohol
37	Xylene

Gear Lubricant Composition
Figure 501

5. ALIGNMENT.

A. Dial Drum Vertical Alignment.

Rotate shift lever collar (138/135) on band-switch shaft (146) and tighten two setscrews (136) when collar (138/135) is in position such that:

(1) Numbers and markings of each band are clearly visible through plastic window (26) when band switch (8/11) is in appropriate position.

(2) Top of dial drum (186) does not rub against frame (188/201) when band selector (11) is in .84-1.75 position.

(3) Bottom of dial drum (186) does not rub against frame (188/201) when band selector (11) is in .19-.40 position.

B. Dial Drum Rotational Limits.

(1) Use the TUNE control (5) to rotate the dial drum (186) to the end of a band.

(2) Set the band selector (11) to the .19-.40 position.

(3) Loosen two setscrews (126) to allow worm gear (131) to be rotated independently of tuning control shaft (124).

(4) Find a position of the tuning shaft (124) such that the ends of the dial drum band (186) are the same distance from the hairline for full clockwise and counterclockwise rotation of the TUNE shaft (124).

(5) Lightly tighten one setscrew (126).

(6) Apply pressure to the rear of the tuning control shaft (124) so that between 0.030 and 0.040 inch of pin 190 engages the first bent washer (128). Retain tuning control shaft (124) in this position.

(7) Hold collar (125) and worm gear (131) against bearing (192).

(8) Check that dial drum (186) is in position indicated in step (4).

(9) Tighten two setscrews (126). Release pressure on control shaft assembly (122).

C. Synchro to Dial Drum.

NOTE: All pin connections refered to in this paragraph are for connector P301. Connection may be made through individual clips or through a female Scintilla PT06A-20-41S connector. Numbers in parentheses refer to female Scintilla MS-24266R-18B31S.

(1) Connect pins a (11), M (28), and Z (10) to ground.

(2) Apply 26 volts ac, 400 cps to pin H (25).

(3) Connect a Ballantine model 310A vacuum-tube voltmeter, or equivalent, to pin X (8). Connect meter ground to pin Z (10).

(4) Set mode switch (18) to ADF position.

(5) Set the band switch (11) to the .84-1.75-megacycle range.

(6) Rotate TUNE control (5) until small circle to the right of the 1.4-megacycle mark on the dial drum (186) is bisected by the hairline.

(7) Loosen two setscrews (167).

NOTE: Do not allow spur gear (168) or spur gear (170) to become disengaged from spur gear (154). Disengagement will cause loss of spring (169) loading between spur gears (168, 170). Refer to paragraph 3.I. of this section to restore spring loading.

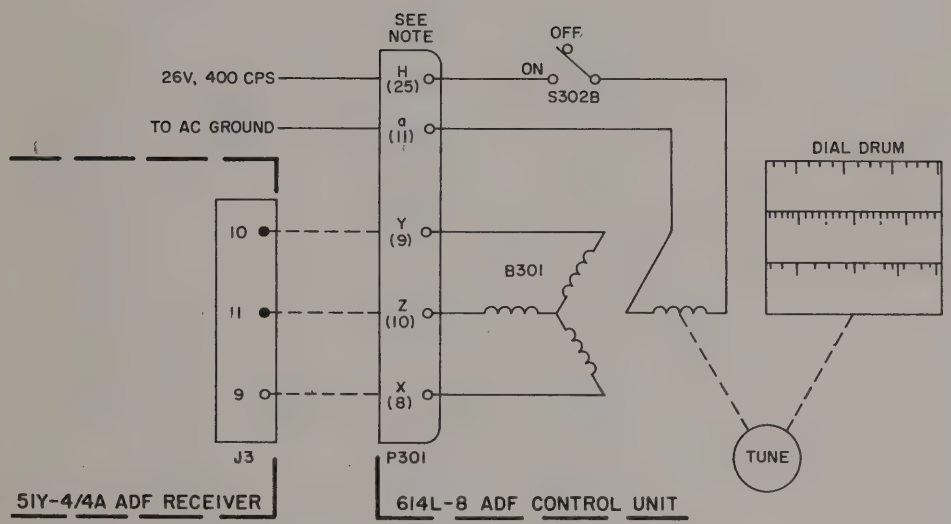
(8) Use narrow-bladed screwdriver to rotate the synchro shaft (174) until the ac voltmeter indicates a null.

(9) Tighten two setscrews (167) checking that voltmeter retains null reading.

(10) Connect ac voltmeter to pin H (25) and voltmeter ground to pin Y (9).

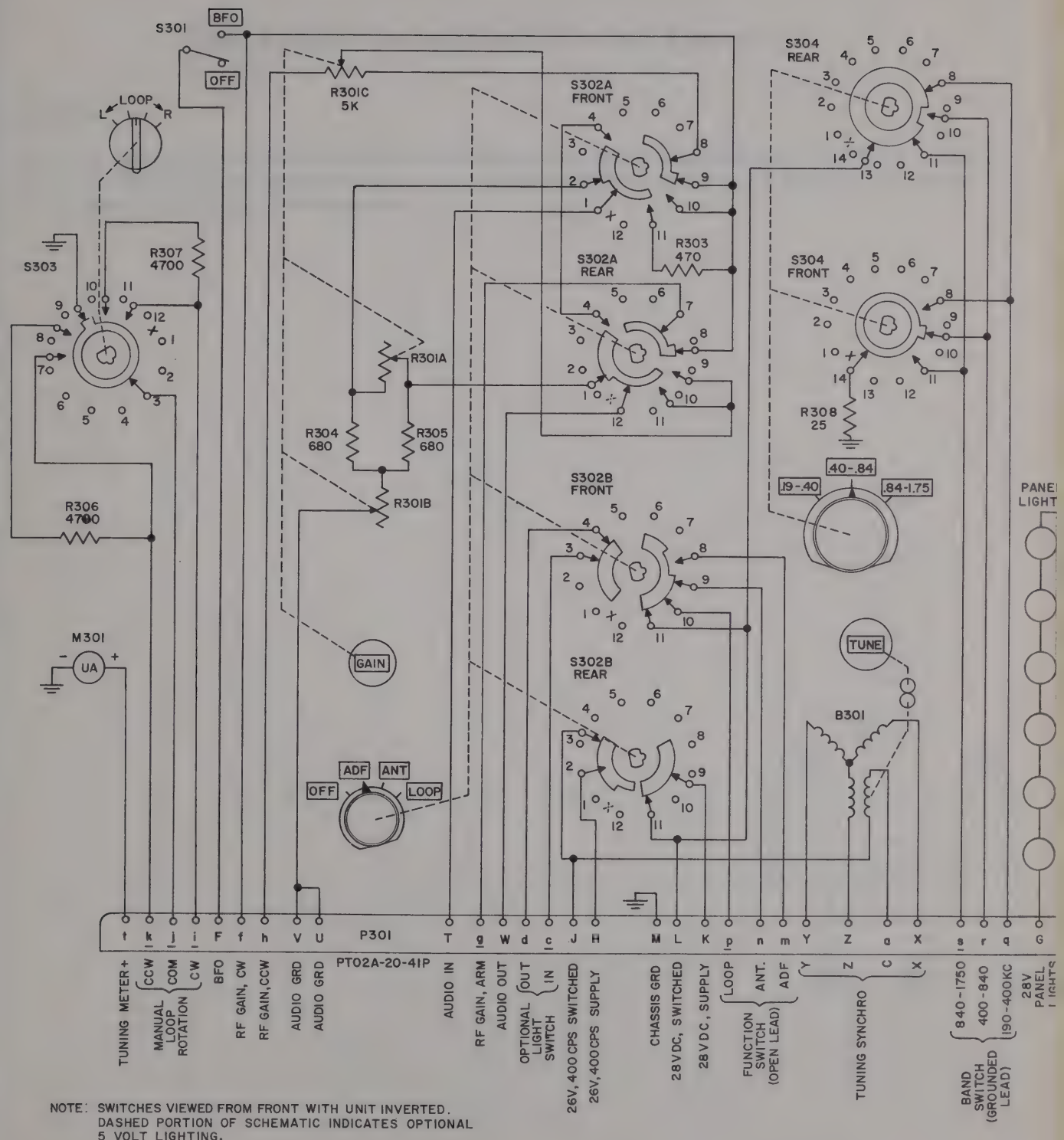
(11) If voltmeter reads more than 26 volts, proceed to step (12). If voltmeter reads less than 26 volts, repeat step (7), rotate the synchro shaft 180 degrees, and repeat steps (8) through (11).

(12) Tighten two setscrews (167).



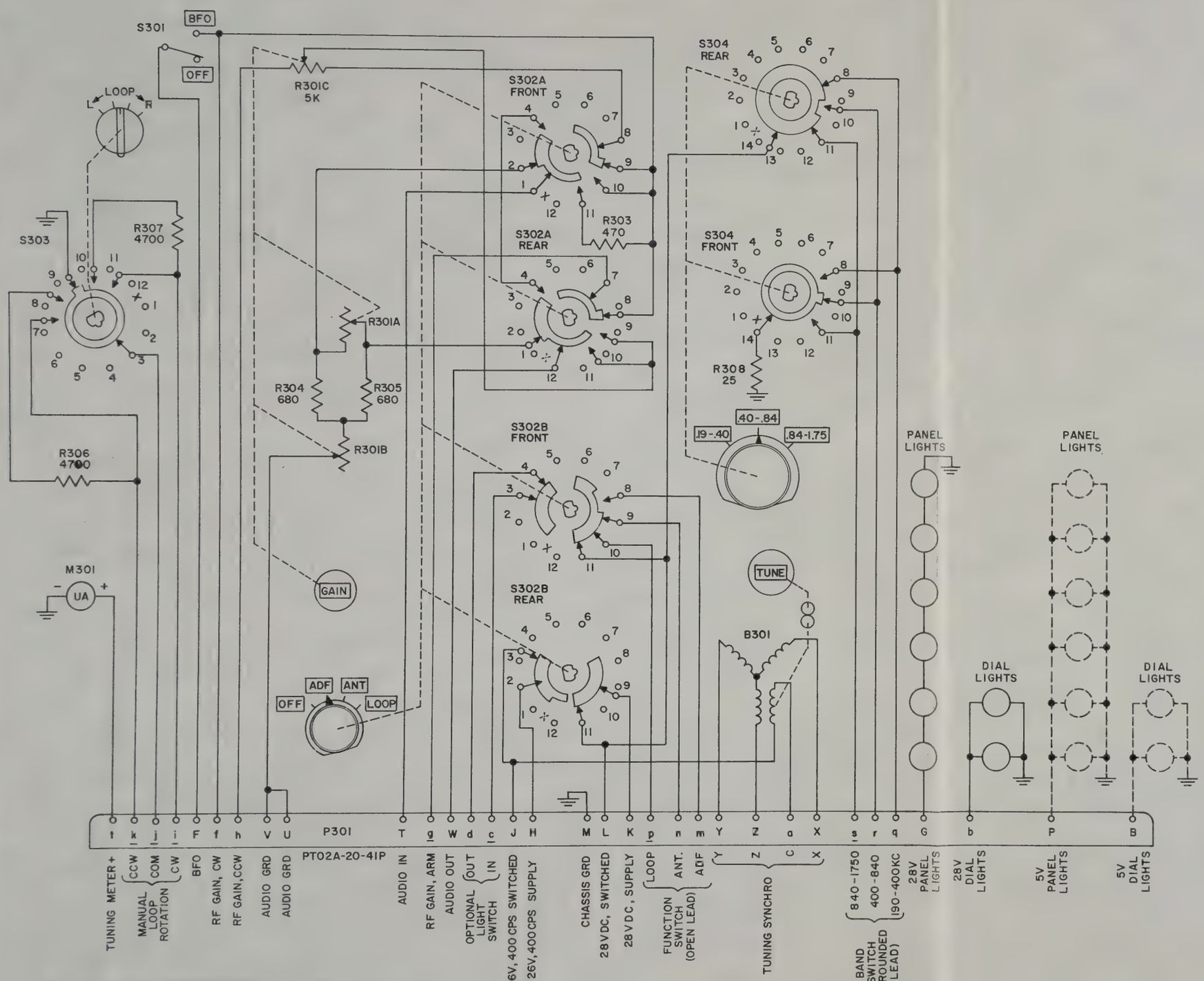
NOTE:
NUMBERS IN PARENTHESIS REFER TO 614L-8 ADF CONTROL UNIT WITH COLLINS PART NUMBERS 522-2357-014, 522-2357-016, 522-2357-018.

Tuning Circuit, Simplified Schematic Diagram
Figure 11



NOTE: SWITCHES VIEWED FROM FRONT WITH UNIT INVERTED.
DASHED PORTION OF SCHEMATIC INDICATES OPTIONAL 5 VOLT LIGHTING.

614L-8 ADF Control Unit (Collins Part Numbers 522-2357-00, 522-2357-011, 522-2357-012, 522-2357-013, 522-2357-017, and 522-2357-019), Schematic Diagram
Figure 801



NOTE: SWITCHES VIEWED FROM FRONT WITH UNIT INVERTED.
DASHED PORTION OF SCHEMATIC INDICATES OPTIONAL 5 VOLT LIGHTING.

614L-8 ADF Control Unit (Collins Part Numbers 522-2357-00, 522-2357-011, 522-2357-012, 522-2357-013, 522-2357-017, and 522-2357-019), Schematic Diagram
Figure 801

PANEL
LIGHTS
DIAL
LIGHTS
DIAL
LIGHTS
28V
DIAL
LIGHTS
5V
PANEL
LIGHTS
5V
DIAL
LIGHTS

614L-8 ADF Control Unit - Fits and Clearances

1. GENERAL.

Included within this section is reference information for fits and clearances of the 614L-8 ADF Control Unit. Fits and clearances are closely associated with assembly of the 614L-8. Refer to the assembly section of this manual.

614L-8 ADF Control Unit - Testing

1. GENERAL.

Included within this section are the procedures for bench testing the 614L-8 ADF Control Unit. Probable cause of an abnormal indication is included after each test. Reference is made to alignment instructions in the assembly section of this manual when faulty operation may be due to poor adjustment. Refer to figure 801 for 614L-8 schematic.

2. EQUIPMENT REQUIRED.

Refer to figure 1001 for test equipment required for test. The suggested test fixture used for testing and troubleshooting is shown in figure 1002.

3. TEST PROCEDURES.

NOTE: Electrical connection to the control unit is made to P301. Individual connections, referred to by the designating letter of the pin, may be made using clips or through a female type Scintilla PT06A-20-41S connector (or MS-24266R-18B31S). For connector MS-24266R-18B31S, use numbers in parentheses for pin numbers.

A. Vertical Alignment of Dial Drum.

Check that dial drum (186) is aligned to satisfy the following:

(1) Numbers and markings of each band are clearly visible through plastic window (26) when band selector (11) is in position corresponding to that band.

(2) Top of dial drum (186) does not rub against frame (188/201) when band selector (11) is in .84-1.75 position.

(3) Bottom of dial drum (186) does not rub against frame (188/201) when band selector (11) is in .19-.40 position.

Failure of dial drum (186) positioning to satisfy any of these requirements may be corrected by following the procedure in paragraph 5.A. of the assembly section of this manual. If the alignment procedure does not restore normal operation, check for the following:

(a) Shaft collar (138/135) loose or missing pin (137).

(b) Lever (142) broken or missing pin (141).

(c) Detent wheel (146) not secured to band-switch shaft (147).

(d) Band-switch shaft assembly (147) and function switch shaft assembly (77) interchanged.

(e) Detent followers (144, 66) interchanged.

B. Rotational Limits of TUNE Control.

(1) Set the band selector (11) to the .19-.40 position.

(2) Rotate the TUNE control (5) fully clockwise. Note the distance between the hairline and the end of the band on the dial drum (186).

(3) Rotate the TUNE control (5) fully counterclockwise. Note the distance between the hairline and the end of the band on the dial drum (186).

(4) The distance in step (2) and the distance in step (3) should be nearly the same.

Failure to obtain the proper spacing is caused by the following:

(a) Turn counter composed of washers (127, 128) incorrectly assembled. Refer to assembly section of this manual.

(b) Pin (190) bent.

(c) Loose gears (151, 131).

C. Synchro Dial Drum Alignment.

(1) Connect pins a (11), M (28), and Z (10) to ground.

(2) Apply 26 volts ac, 400 cps to pin H (25).

(3) Connect vacuum-tube voltmeter to pin X (8). Connect meter ground to pin Z (10).

(4) Set mode switch (18) to ADF position.

(5) Rotate TUNE control (5) until voltmeter indicates a null.

(6) Hairline should bisect small circle to right of 1.4-megacycle mark. Failure to obtain this indication may be corrected by referring to paragraph 5.C. of the assembly section of this manual.

(7) Connect vacuum-tube voltmeter to pin H (25). Connect meter ground to pin Y (9).

(8) Vacuum-tube voltmeter should indicate more than 26 volts ac.

Failure to obtain normal indication is evidence of:

(a) Faulty synchro (174).

(b) Incorrectly connected synchro (174). Compare wiring with schematic diagram.

(c) Bad contact on mode switch (18).

(d) Incorrect synchro (174) alignment.

D. Switches.

Use multimeter to check for continuity as indicated in figure 701. An abnormal indication is evidence of faulty switch contacts. Refer to the schematic diagram, figure 801, for the switch section associated with a particular continuity check. Pins designated by letters in figure 701 are for PT02A-20-41P connector. For corresponding pins on MS-24264R-18B31P, refer to numbers in parentheses.

SWITCH	POSITION	CHECK FOR CONTINUITY*		CHECK FOR OPEN*	
		FROM	TO	FROM	TO
		(P301 pins)		(P301 pins)	
BFO	OFF			F (23)	f (14)
	ON	F (23)	f (14)		
Mode	OFF			H (25) c (29) L (27)	J (13) d (22) m, n, p, K (2) (3) (4) (26)
	ADF	H (25) c L (27)	J (13) d K, n, p (26), (3), (4)	L (27) (29)	m (2)
	ANT	H (25) c L (27)	J (13) d K, m, p (26), (2), (4)	L (27) (29)	n (3) (22)
	LOOP	H (25) c L (27)	J (13) d K, m, n (26), (2), (3)	L (27) (29)	n (4) (22)
Band	.19-.40	L (27) M (28)	r, s (6), (7), q (5) 25 ±3 ohms	L (27) M (28)	q (5) r, s (6), (7)

Switch Continuity Check (Sheet 1 of 2)
Figure 701

SWITCH	POSITION	CHECK FOR CONTINUITY*		CHECK FOR OPEN*	
		FROM	TO	FROM	TO
		(P301 pins)		(P301 pins)	
Band (Cont)	.40-.84	L (27) M (28)	q, s (5), (7) r (6) 25 ±3 ohms	L (27) M (28)	r (6) q, s (5), (7)
	.84-1.75	L (27) M (28)	q, r (5), (6) s (7) 25 ±3 ohms	L (27) M (28)	s (7) q, r (5), (6)
LOOP	Left	j (18)	k (19)	j (18)	M, i (28), (17)
	1/2 left	j (18)	k (19) 4.7 ±0.5 kilohms	j (18)	M, i (28), (17)
	Center	j (18)	M (28)	j (18)	K, i (26), (17)
	1/2 right	j (18)	i (17) 4.7 ±0.5 kilohms	j (18)	M, k (28), (19)
	Right	j (18)	i (17)	j (18)	M, k (28), (19)

*Numbers in parentheses refer to 614L-8 ADF Control Units with Collins part numbers 522-2357-014, 522-2357-016, and 522-2357-018.

Switch Continuity Check (Sheet 2 of 2)
Figure 701

E. Gain Control.

(1) Measure resistance between pins f (14) and h (16) with mode switch in ADF, ANT, and LOOP positions. Resistance in ADF and ANT positions should be the same, between 4 and 6 kilohms. Resistance in LOOP position should be 400 to 650 ohms greater than reading in ANT and ADF positions.

Failure to obtain a normal indication is caused by either faulty attenuator, mode switch, or resistor R303.

(2) Measure resistance between pins f(14) and g(15) with function switch in ANT position and GAIN control fully clockwise and counterclockwise. Resistance is clockwise position should not exceed 25 ohms. Resistance in fully counterclockwise position should be 4,000 to 6,000 ohms.

A faulty attenuator is indicated if normal indication cannot be obtained.

(3) Measure resistance between pins f(14) and g(15) with function switch in LOOP position and GAIN control fully clockwise and counterclockwise. Resistance in clockwise position should be less than 550 ohms. Resistance in counterclockwise position should be 4.4 to 6.4 kilohms.

Failure to obtain this reading is caused by bad contacts on mode switch (S302A rear).

(4) Connect output of audio oscillator across pins T(30) and U(31).

(5) Connect a 600-ohm resistor between pins W(20) and V(31).

(6) Connect vacuum-tube voltmeter across the audio oscillator.

(7) Adjust the output of the oscillator to 7.75 volts rms and 400 cps.

(8) Connect the vacuum-tube voltmeter across 600-ohm resistor of step (6) with meter ground connected to pin V(31).

(9) Measure the output across 600-ohm resistor with GAIN control fully clockwise, one turn from fully clockwise, and fully counterclockwise. The limits of these voltages for each of the three signal positions of the mode switch appear in figure 702.

Failure to obtain correct readings is evidence of faulty attenuator, R304, R305, or mode switch contacts (S302A rear and front).

MODE SWITCH POSITION	GAIN CONTROL POSITION	OUTPUT (across 600 ohms, rms)
ADF	Clockwise	7.6 volts min
ANT	Clockwise	7.6 volts min
LOOP	Clockwise	7.6 volts min
ADF	One turn from clockwise	0.77 to 2.45 volts
ANT	One turn from clockwise	7.6 volts min

Gain Control Measurements (Sheet 1 of 2)
Figure 702

MODE SWITCH POSITION	GAIN CONTROL POSITION	OUTPUT (across 600 ohms, rms)
LOOP	One turn from clockwise	7.6 volts min
ADF	Counterclockwise	0.024 volt max
ANT	Counterclockwise	7.6 volts min
LOOP	Counterclockwise	7.6 volts min

Gain Control Measurements (Sheet 2 of 2)
Figure 702

F. Tuning Meter.

(1) Apply +27.5 volts dc in series with 470 kilohms ±1 percent to pin t (1).

(2) Connect pin M (28) to +27.5-volt dc source ground.

(3) Tuning meter should read 55 to 65 microamperes.

NOTE: Tuning meter full-scale reading is 100 microamperes. Each scale devision is 20 microamperes.

Failure to obtain correct meter reading is evidence of faulty meter movement.

G. Dial Drum and Panel Lamps.

The panel lighting voltage for the 614L-8 is dependent upon the part number. Part numbers 522-2357-00, 522-2357-011, and 522-2357-019 require 28 volts connected to pins b and G with pin M used as the ground return. Part numbers 522-2357-012, 522-2357-013, and 522-2357-017 require 5 volts connected to pins B and P with pin M used as the ground return. Part numbers 522-2357-014 and 522-2357-016 require 5 volts connected to pins 12 and 24 with pin 28 used as the ground return. Part number 522-2357-018 requires 28 volts connected to pin 22 with pin 28 used as the ground return. After connection has been made, visually check that panel and dial drum are properly illuminated.

H. Frequency Calibration.

(1) Connect test fixture shown in figure 1002 to P301 of 614L-8 ADF Control Unit.

(2) Connect vacuum-tube voltmeter between R and ground.

(3) Set the test fixture dial to each of the positions indicated in figure 703.

(4) For each of the positions of step (3), adjust the TUNING control so that the vacuum-tube voltmeter reads a null. When null is approached from either right or left, hairline should fall within the edges of the appropriate frequency mark given in second column of figure 703. The numbers in parentheses refer to 614L-8 ADF Control Unit with part number 522-2357-018.

Failure of frequency marks to appear under the hairline indicates a faulty synchro.

TEST FIXTURE DIAL POSITION (degrees)	*614L-8 DIAL DRUM READING
.19-.40 BAND (190-400)	
11.8	.19 (190)
25.9	.20 (200)
47.4	.22 (220)
64.2	.24 (240)
78.5	.26 (260)
91.1	.28 (280)
115.4	.32 (320)
127.6	.34 (340)
140.1	.36 (360)
153.3	.38 (380)
167.9	.40 (400)
.40-.84 BAND (400-840)	
13.3	.40 (400)
166.8	.84 (840)
.84-1.75 BAND (840-1750)	
16.1	.85 (850)
163.6	1.75 (1750

*Numbers in parentheses refer to 614L-8 ADF Control Unit with Collins part number 522-2357-018.

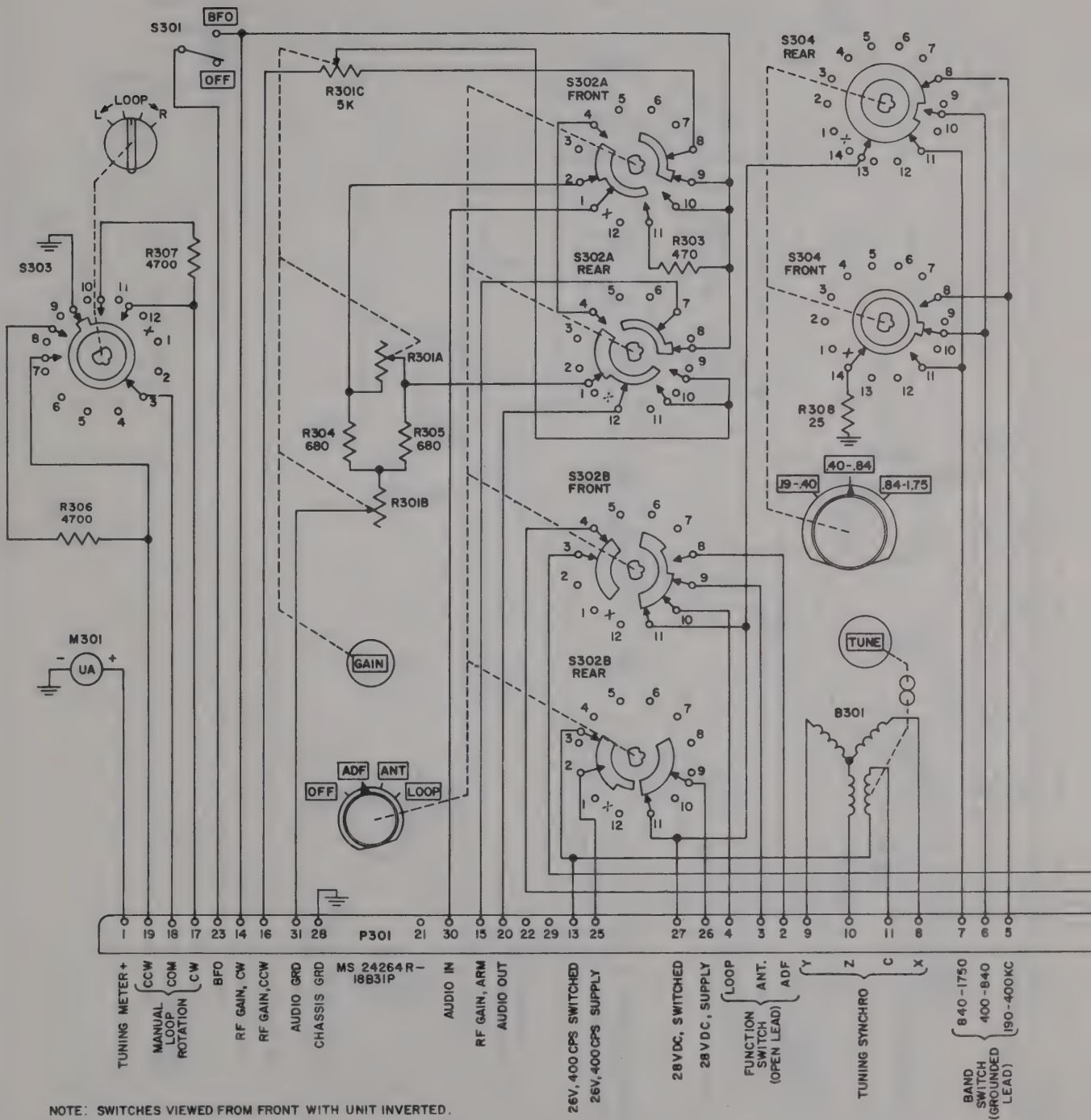
Frequency Calibration
Figure 703

614L-8 ADF Control Unit - Troubleshooting

1. GENERAL.

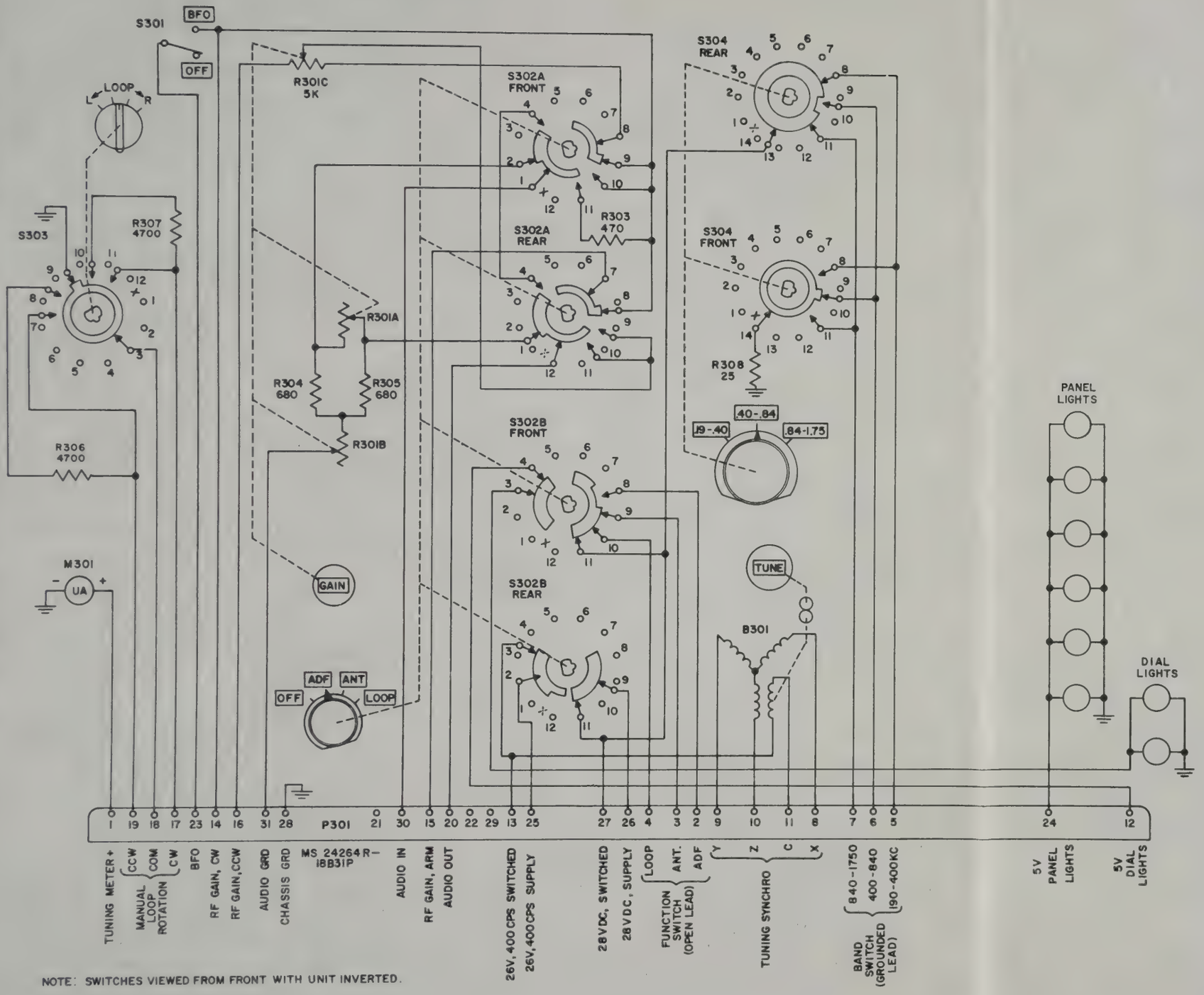
Troubleshooting of the 614L-8 ADF Control Unit is best accomplished by a systematic testing procedure. Troubleshooting data is provided in the testing section of this manual. Specific troubleshooting data and references to appropriate alignment procedures are shown at the end of each check.

As a further aid to troubleshooting, refer to the 614L-8 schematic diagrams, figures 801, 802 and 803.



NOTE: SWITCHES VIEWED FROM FRONT WITH UNIT INVERTED.

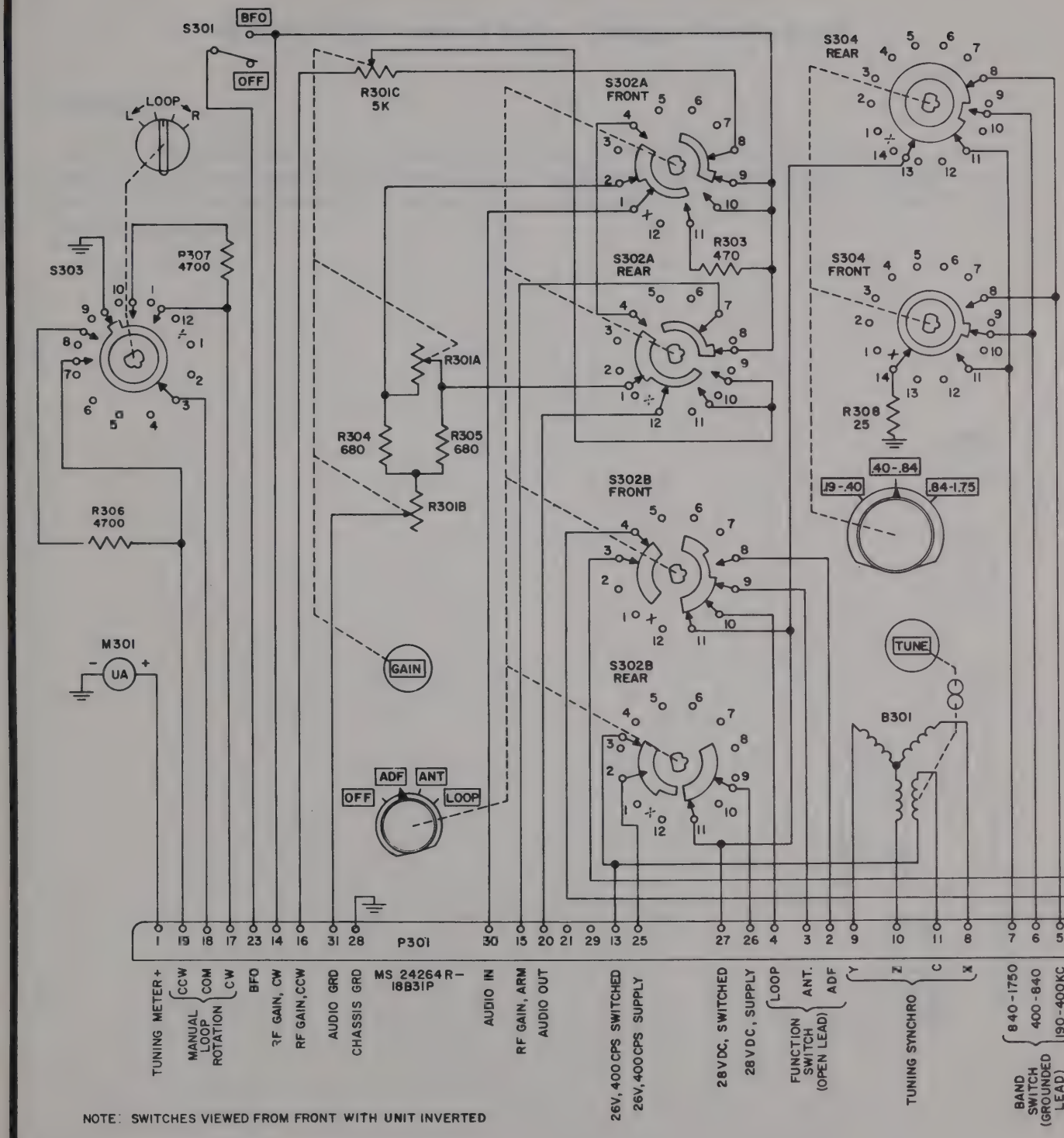
614L-8 ADF Control Unit (Collins Part Number 522-2357-014 and 522-2357-016), Schematic Diagram
Figure 802



NOTE: SWITCHES VIEWED FROM FRONT WITH UNIT INVERTED.

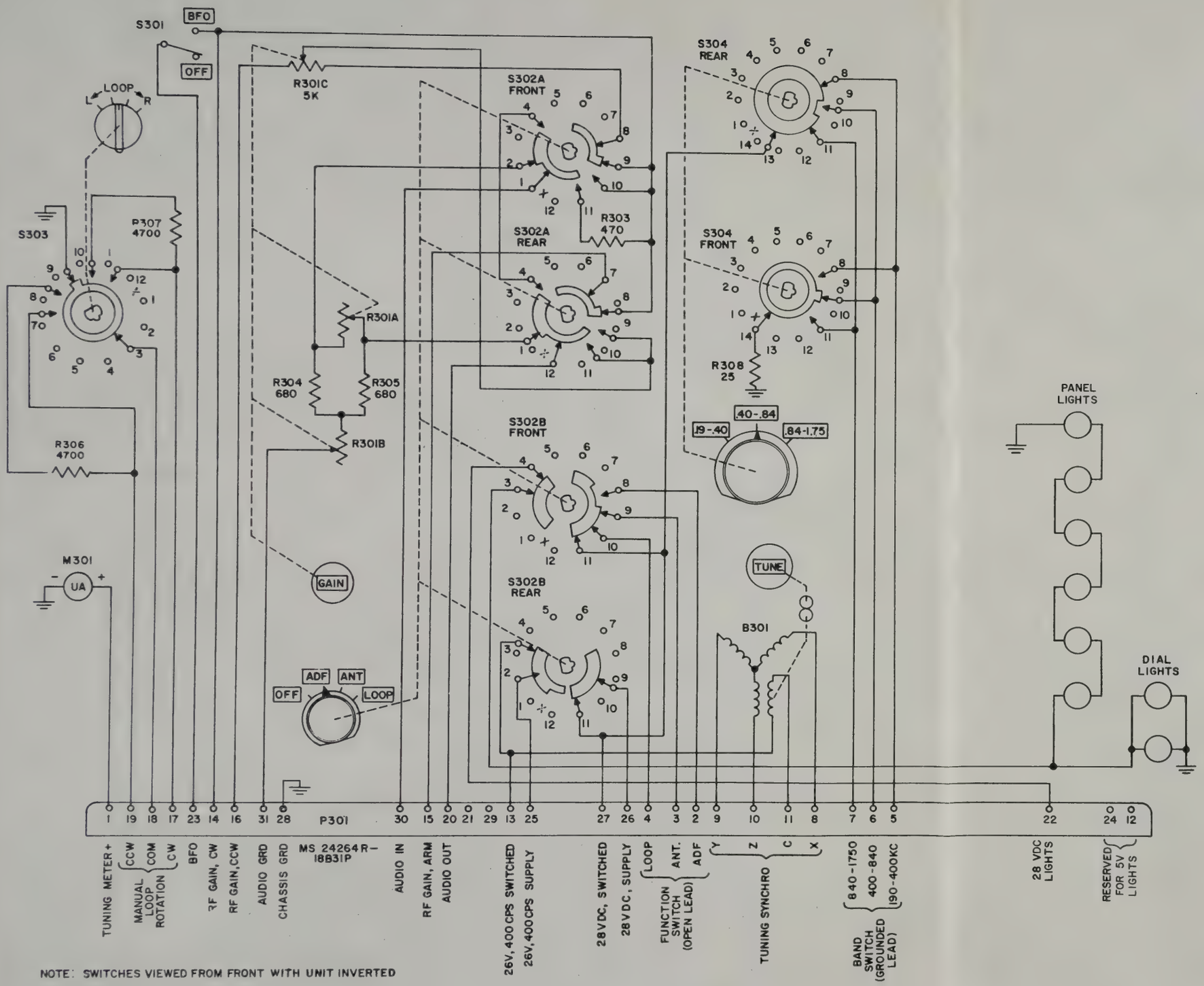
614L-8 ADF Control Unit (Collins Part Number 522-2357-014 and 522-2357-016), Schematic Diagram
Figure 802

PANEL
LIGHTS
DIAL
LIGHTS
24
12
5V
PANEL
LIGHTS
5V
DIAL
LIGHTS



614L-8 ADF Control Unit (Collins Part Number 522-2357-018),
Schematic Diagram
Figure 803

PANEL
LIGHTS
DIAL
LIGHTS
24
12
5V
PANEL
LIGHTS
5V
DIAL
LIGHTS



NOTE: SWITCHES VIEWED FROM FRONT WITH UNIT INVERTED

614L-8 ADF Control Unit (Collins Part Number 522-2357-018),
Schematic Diagram
Figure 803

PANEL
LIGHTS
DIAL
LIGHTS
22
24
12
28 VDC
LIGHTS
RESERVED
FOR 5V
LIGHTS

614L-8 ADF Control Unit - Storage Instructions

1. GENERAL.

Included within this section are storage instructions for the 614L-8 ADF Control Unit. Make certain that all components are secured to the chassis and that the equipment is installed in the dust cover. If the equipment is to be stored for a prolonged period, place the equipment in the original shipping carton.

614L-8 ADF Control Unit - Special Tools, Fixtures, and Equipment

1. GENERAL.

Included within this section is a list of special tools, fixtures, and test equipment required for the test or overhaul.

2. TEST EQUIPMENT REQUIRED.

Figure 1001 lists the equipment required to test, troubleshoot, and overhaul the unit. Any substitution of test equipment must be equivalent to, or better than, that which is listed.

EQUIPMENT	MANUFACTURER AND PART NUMBER	FUNCTION
Multimeter	Simpson Electric Company Model 610	Continuity and resistance measurements.
Ac vacuum-tube voltmeter	Ballantine Instruments Inc. Model 310A	Detecting voltage null and amplitude of synchro output.
Audio oscillator	Hewlett-Packard Inc. Model 200CD	Provides signal input for testing attenuator.
Synchro test fixture	To be locally fabricated (see figure 1002)	Frequency calibration of 614L-8 dial.

Table of Test Equipment Required
Figure 1001

Figure 1002 shows a suggested test fixture. The test fixture should be fabricated for testing and troubleshooting.

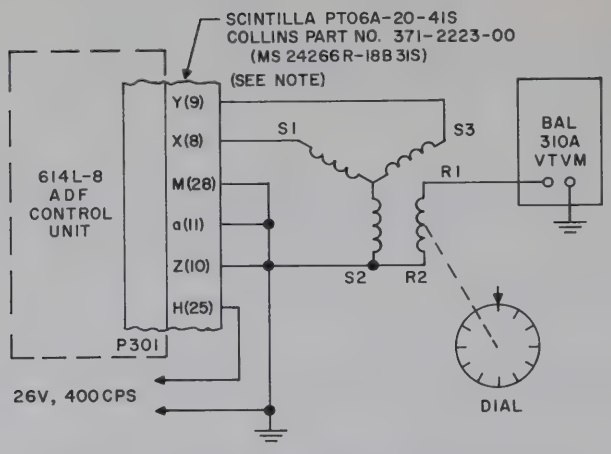
3. SYNCHRO TEST FIXTURE.

A. Component Description

(1) Standard synchro control transmitter, Collins part number 229-5003-00, having less than 3-minute maximum error.

(2) Calibrated dial capable of positioning shaft of synchro transmitter within ±0.05 degree.

(3) Connector, Scintilla model PT06A-20-41S (MS-24266R-18B31S), used to make connection to control box.



NOTE:
NUMBERS IN PARENTHESIS REFER TO 614L-8 ADF CONTROL UNIT WITH COLLINS PART NUMBERS 522-2357-014, 522-2357-016 AND 522-2357-018.

Synchro Test Fixture, Schematic Diagram
Figure 1002

B. Assembly.

(1) Connect components in section 3.A. of this section as illustrated in figure 1002.

(2) Secure the dial to the synchro shaft so that:

(a) When the dial reads 90 degrees, the voltage between S1 and S2 is a minimum. Voltage is measured with vacuum-tube voltmeter with 400 cps ac applied to test fixture as indicated.

(b) When dial reads 90 degrees, the voltage between S3 and R1 is greater than 26 volts ac. If voltage is less than 26 volts ac, rotate synchro shaft 180 degrees with respect to dial.

(c) When dial reading is increased from 90 degrees, the voltage between S3 and S2 increases then decreases.

614L-8 ADF Control Unit - Illustrated Parts List

INTRODUCTION

1. GENERAL.

This Illustrated Parts List is a complete list of parts for the above equipment manufactured by Collins Radio Company (see figure 1101).

Periodically the Illustrated Parts List is revised to cover additions, deletions, or changes to the equipment. These revisions are indicated by an R placed to the left of each revised item and apply to the current revision only.

2. NUMERICAL INDEX.

This index contains an alphanumerical list of all parts listed in the Group Assembly Parts List.

A. PART NUMBER Column.

In this column are listed part numbers for procurable parts and assemblies in the Group Assembly Parts List.

(1) Order of Precedence.

The order of precedence beginning at the extreme left-hand position in part number numerical arrangement is as follows:

Letters A through Z
Numerals 0 through 9 (Alphabetical O's are considered as numerical zeros.)

The order of precedence in continuing the part number arrangement in second and succeeding positions of the part number from left to right is as follows:

Space (blank column)
Diagonal (slant)/
Point (period).
Dash (-)
Letters A through Z
Numerals 0 through 9 (Alphabetical O's are considered as numerical zeros.)

(2) Collins Radio Company Part Numbering System.

Collins Radio Company part numbering system is comprised of a three-digit family number, a four-digit serial number, and a two- or three-digit dash number:

FAMILY NO.	SERIAL NO.	DASH NO.
XXX	XXXX	XX or XXX

B. AIRLINE PART NO. Column.

Intentionally left blank, for Airline use only.

C. FIG.-ITEM Column.

This column lists the Group Assembly Parts List figure and item numbers assigned to the associated part numbers.

D. TTL REQ (Total Required) Column.

Total quantity of parts or assemblies required at each location is listed in this column.

3. SYMBOL INDEX.

The symbol index enables the user to locate, by symbol, the part number and the figure and item number of any electrical item that appears on the schematic diagram.

A. SYMBOL Column.

This column contains an alphanumerical listing of all symboled items. When the same symbol appears in different units or subassemblies, module symbol prefix designators are used. Where no prefix has been assigned, separate indexes will be given. Prefix designators, if required, will be found in paragraph 7.

B. PART NUMBER Column.

This column contains the part number for all symboled items.

C. FIG.-ITEM Column.

The figure and item numbers are used to locate a part in the Group Assembly Parts List after it has been located in the Symbol Index.

4. COMMERCIAL HARDWARE LIST.

This list contains all commercially available hardware items used with the equipment.

A. PART NUMBER Column.

This column contains part numbers for commercial hardware.

B. NOMENCLATURE Column.

This column contains a description of all commercially available hardware including the type of material, dimensions, and type of finish.

INTRODUCTION

5. GROUP ASSEMBLY PARTS LIST.

A. General.

The Group Assembly Parts List consists of a breakdown of the complete unit into subassemblies and detailed parts. Each assembly is listed in its order of disassembly and is followed immediately by its component parts properly indented to show their relationship to the assembly.

(1) FIG.-ITEM Column.

Figure and item numbers key the parts breakdown to the applicable illustration. Items in the parts breakdown preceded by a dash (example -1) will not be keyed on the illustration.

(2) PART NO. Column.

Part numbers listed are MIL part numbers, vendor part numbers, or Collins part numbers.

(3) Proprietary Items.

Proprietary items are coded P and appear in the nomenclature column.

(4) NOMENCLATURE Column.

In this column are listed each assembly, subassembly, sub-subassembly, a reference to its next higher assembly (NHA), and their attaching parts; attaching parts are listed immediately following the parts which they attach. Items which are made from raw stock, such as cut lengths of wire, solder, varnish, lacing cord, and flexible tubing are not included in the Group Assembly Parts List.

If a part is purchased by Collins Radio Company from a vendor, the Federal Manufacturer's Code number, preceded by the letter V, is listed in this column. The vendor's part number will be listed in the part number column, and the Collins part number will appear in the nomenclature column. If this column does not include a Federal Manufacturer's Code number, the part number listed is a Collins part number. The vendor's name and address are indicated in paragraph 6. Symbol designations, where applicable, will be listed following the Collins part number. Serial number or MCN (manufacturing control number) effectivities, where applicable, are listed following the last item in this column. Serial number effectivities are designated on nameplates. The MCN is stamped on each module and/or chassis. This Illustrated Parts List reflects changes made by field service bulletins. Notices of such changes are added at the end of the description in the nomenclature column.

(5) USAGE CODE Column.

Part variations within different models of the same equipment are indicated in the usage code column. In cases where this column has been left blank, the part listed will apply to all models of equipment covered by this publication. If usage codes are required, see paragraph 7.

(6) UNITS PER ASSY. Column.

This column contains the number of parts required for each assembly or subassembly. The letters AR denote that the selection of a part or parts should be made as required. REF refers to an assembly which is completely assembled on a preceding illustration.

INTRODUCTION

6. VENDOR'S CODE AND NAME INDEX.

CODE	VENDOR'S NAME AND ADDRESS
01121	Allen-Bradley Co. 136W. Greenfield Ave. Milwaukee 4, Wis.
02660	Amphenol-Borg Electronics Corp. 2801 South 25th Ave. Broadview (Chicago), Ill.
08719	Jay-El Products, Inc. 1854 A West 169th St. Gardena, Calif.
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
09922	Burndy Corp. Norwalk, Conn.
12014	Chicago Rivet and Machine Co. 950 S. 25th Ave. Bellwood, Ill.
70417	Amplex Division of Chrysler Corp. P.O. Box 2718 Detroit 31, Mich.
71279	Cambridge Thermionic Corp. 445 Concord Ave. Cambridge 38, Mass.
71744	Chicago Miniature Lamp Works 4433 Ravenswood Ave. Chicago 40, Ill.
72794	Dzus Fasterner Co., Inc. 125 Union Ave. West Islip, N.Y.
72962	Elastic Stop Nut Corp. of America 2330 Vauxhall Road Union, N.J.
73957	Groov-Pin Corp. 1125 Hendricks Causeway Ridgefield, N.J.
76854	Oak Mfg. Co., Electronic Components 200 E. Crystal Lake Ave. Crystal Lake, Ill.
77147	Patton Mac Guyer Co. 17 Virginia Ave. Providence 5, R.I.
77250	Pheoll Mfg. Co. 5700 Roosevelt Road Chicago, Ill.
77820	Bendix Corp. Scintilla Division Delaware St. Sidney, N.Y.
78189	Shakeproof Division of Illinois Tools Works St. Charles Road Elgin, Ill.
79136	Waldes Kohinoor, Inc. 4716 Austell Place Long Island City 1, N.Y.
79807	Wrought Washer Mfg. Co. 2100 South Bay St. Milwaukee 7, Wis.
81030	International Instruments, Inc. 88 Marsh Hill Rd. Orange, Conn.
81640	Hetherington, Inc. Folcroft, Pa.
82104	Grigsby Allison Co., Inc. 407 N. Salem Ave. Arlington Heights, Ill.
83584	Driv Lok Pin Co. Sycamore, Ill.

CODE	VENDOR'S NAME AND ADDRESS	CODE	VENDOR'S NAME AND ADDRESS
86197	Clifton Precision Products Co. Marple at Broadway Clifton Heights, Pa.	89462	Waldes Kohinoor, Inc. Cambridge, Mass.
86577	Precision Metal Products of Malden, Inc. 41 Elm St. Stoneham 80, Mass.	91637	Dale Electronics, Inc. 1370 28th Ave. Columbus, Neb.

7. TABLE I.

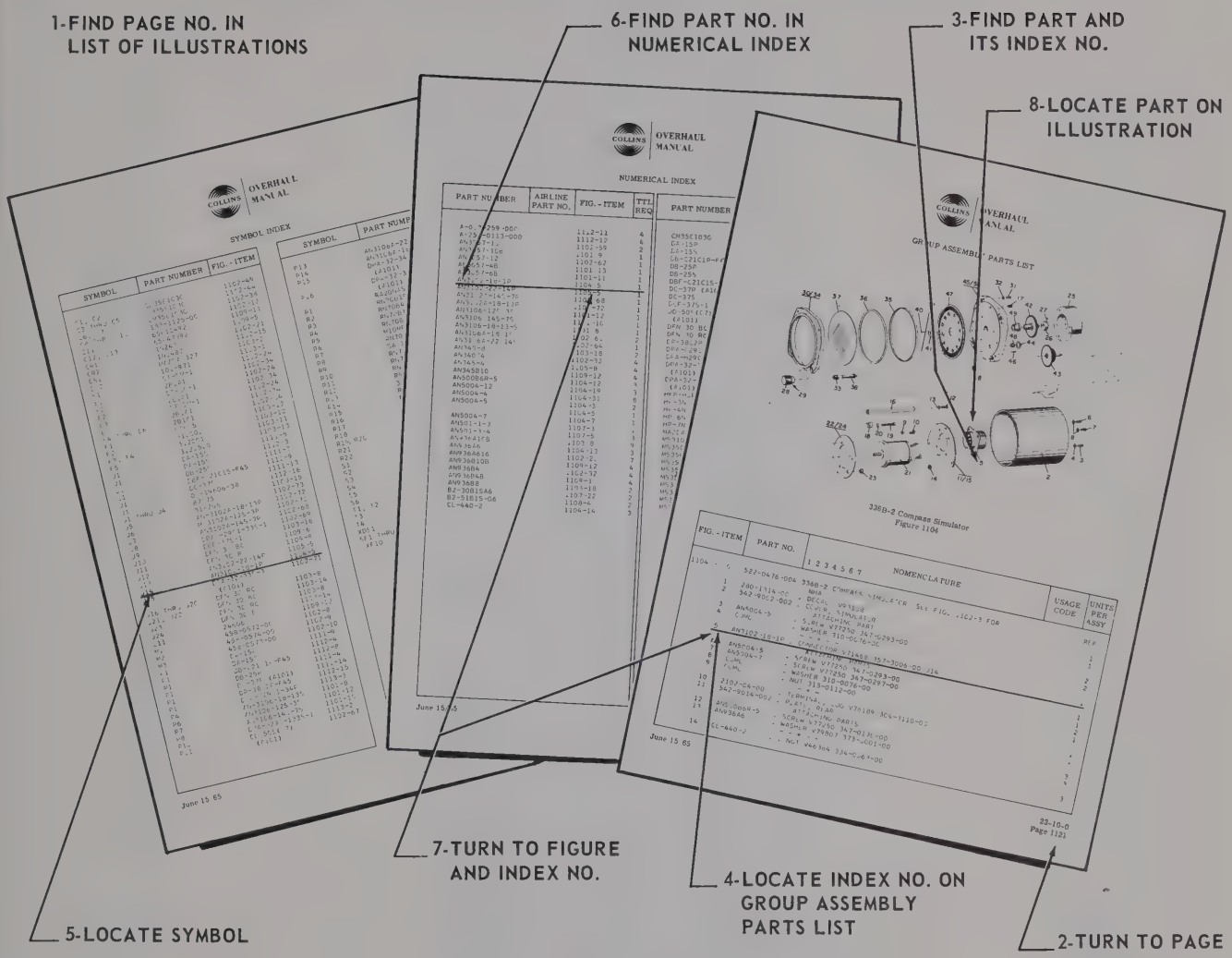
A. Usable on Codes.

The following codes have been assigned in this manual:

USE ON CODE	UNIT		FIGURE
A	614L-8	522-2357-00	1101
B	614L-8	522-2357-011	1101
C	614L-8	522-2357-012	1101
D	614L-8	522-2357-013	1101
E	614L-8	522-2357-014	1101
F	614L-8	522-2357-016	1101
G	614L-8	522-2357-017	1101
H	614L-8	522-2357-018	1101
J	614L-8	522-2357-019	1101
K	614L-8	522-2357-022	1101

INTRODUCTION

How to Use This Illustrated Parts List


1-FIND PAGE NO. IN LIST OF ILLUSTRATIONS
6-FIND PART NO. IN NUMERICAL INDEX
3-FIND PART AND ITS INDEX NO.
8-LOCATE PART ON ILLUSTRATION
7-TURN TO FIGURE AND INDEX NO.
4-LOCATE INDEX NO. ON GROUP ASSEMBLY PARTS LIST
5-LOCATE SYMBOL
2-TURN TO PAGE
SYMBOL INDEX
NUMERICAL INDEX
GROUP ASSEMBLY PARTS LIST
336B-2 Compass Simulator
Figure 1104

HOW TO FIND THE PART NUMBER IF THE SECTION OR SYSTEM OF THE EQUIPMENT IN WHICH THE PART IS USED IS KNOWN:

(1) Turn to the List of Illustrations and find the page number for the Major Assembly or System in which the part is used.

(2) Turn to the page determined in step (1).

(3) Locate the part and its index number on the illustration.

(4) Find the index number on the Group Assembly Parts List page to determine complete description.

(5) If the reference designation symbol is known, refer to the Symbol Index to find the part number.

HOW TO FIND THE ILLUSTRATION FOR A PART IF THE PART NUMBER IS KNOWN:

(6) Refer to the Numerical Index and find the part number.

(7) Turn to the Group Assembly Parts List and find the first figure and index number indicated in the Numerical Index for that part. If this figure shows the part in a section or system of the equipment other than the one desired, refer to the other figure numbers listed in the Numerical Index.

(8) On the face of the illustration, find the index number determined in step (7).

NUMERICAL INDEX

PART NUMBER	AIRLINE PART NO.	FIG. - ITEM	TTL REQ
AJ3-25CAD		1101-2	2
ORZINCPL			
A206-6MILL6085		1101-200	1
A288-1MILL6085		1101-192	1
A316MILL6085		1101-195	1
BT02A20-41P		1101-87	1
DLB-0625X312-50		1101-141	1
F209-1MILL6085A		1101-194	1
F22NCFMA1-26		1101-120	2
F22NCFMA2-40		1101-41	2
F304-4MILL6085A		1101-199	1
F346-4MILL6085A		1101-195	3
GA3-200CHROMATE		1101-3	2
GP4-062X0375-50		1101-191	2
GP4-093X0500-50		1101-190	1
GP7-093X375-50		1101-193	2
LIGHT ASSY		1101-27	1
MS16633-1015		1101-73	1
MS2065D440A		1101-88	4
MS24264B18B31PNX		1101-87	1
MS24367-1		1101-28	6
MS25237-327R		1101-112	2
MS35200-24		1101-94	1
MS35200-5		1101-114	2
MS35216-1		1101-100	2
MS35216-12		1101-102	4
MS35216-14		1101-62	6
MS35216-15		1101-89	4
MS35216-19		1101-84	2
MS35216-2		1101-44	2
MS35216-26		1101-95	1
MS35216-5		1101-172	3
MS35335-58		1101-96	1
MS35337-77		1101-45	7
MS35337-78		1101-37	12
MS35649-24		1101-51	2
PANEL		1101-24	1
PC3 1-2CADPLYEL		1101-40	4
PF3 1-2 38 CADPLYEL		1101-38	4
PS3 1-2CADPLYEL		1101-39	4
RC07GF103K		1101-54	2
RC07GF153K		1101-54	2
RC07GF333K		1101-54	2
RC07GF472K		1101-54	2
RC20GF471K		1101-58	1
RC20GF681K		1101-56	2
RW31V250		1101-91	1
R4008X1-8 CHROMATEDP		1101-105	4
R4008X7-32 CHROMATEDP		1101-116	1
SPL4040-4 HOTTINNED		1101-108	1
SS5169		1101-119	1
S3-150CHROMATE		1101-104	2
TGC11C4		1101-174	1
T3103		1101-31	1
015-0553-00		1101-92	1
1212SMA00-0044-020		1101-47	1

PART NUMBER	AIRLINE PART NO.	FIG. - ITEM	TTL REQ
1214-05-00-0543		1101-32	1
1720-02-00-4102		1101-49	3
2045X		1101-110	1
3017-4HOTTINNED		1101-107	1
302-0347-00		1101-98	2
309-0062-00		1101-198	1
310-0048-00		1101-130	2
310-0447-00		1101-97	1
310-4714-00		1101-156	1
310-6320-00		1101-46	4
310-6323-00		1101-155	3
3200-021		1101-33	1
334-4120-00		1101-48	2
335-0020-00		1101-6	24
343-0020-00		1101-22	2
347-0007-00		1101-36	4
3502-07-01-0543D		1101-74	2
383-0195-00		1101-69	1
4012 1-4 HOTTINNED		1101-93	1
500-1095-003		1101-7	2
50143		1101-80	1
50148		1101-60	1
50230-4MLR		1101-82	1
503-0643-001		1101-128	5
503-0644-001		1101-127	5
5100-25C		1101-159	2
52032		1101-29	2
522-2357-00		1101-	1
522-2357-011		1101-	1
522-2357-012		1101-	1
522-2357-013		1101-	1
522-2357-014		1101-	1
522-2357-016		1101-	1
522-2357-017		1101-	1
522-2357-018		1101-	1
522-2357-019		1101-	1
522-2357-022		1101-	1
542-4160-002		1101-171	3
542-4177-002		1101-169	2
544-8809-003		1101-23	2
545-7507-003		1101-160	3
548-6761-002		1101-125	5
548-9540-003		1101-118	1
549-3541-00		1101-	1
549-3541-011		1101-	1
549-3541-012		1101-	1
549-3541-013		1101-	1
549-3542-002		1101-184	1
549-3543-002		1101-185	1
549-3544-002		1101-124	1
549-3545-002		1101-148	1
549-3546-002		1101-79	1
549-3547-002		1101-76	1
549-3548-002		1101-146	1
549-3549-002		1101-78	1
549-3552-002		1101-168	1
549-3553-002		1101-170	1
549-3555-002		1101-131	1
549-3556-002		1101-75	1

NUMERICAL INDEX

PART NUMBER	AIRLINE PART NO.	FIG. - ITEM	TTL REQ
549-3557-002		1101-43	1
549-3558-002		1101-5	1
549-3559-002		1101-12	1
549-3560-002		1101-18	1
549-3561-002		1101-11	1
549-3562-002		1101-17	1
549-3562-003		1101-17	1
549-3563-002		1101-10	1
549-3563-003		1101-10	1
549-3564-002		1101-121	1
549-3565-002		1101-34	2
549-3566-002		1101-175	1
549-3568-002		1101-165	1
549-3570-002		1101-147	1
549-3571-002		1101-115	1
549-3572-002		1101-117	1
549-3573-002		1101-179	1
549-3574-002		1101-143	1
549-3575-002		1101-164	1
549-3576-003		1101-19	1
549-3576-004		1101-19	1
549-3576-002		1101-19	1
549-3577-002		1101-189	1
549-3578-002		1101-183	1
549-3580-002		1101-134	1
549-3581-002		1101-158	1
549-3582-002		1101-163	1
549-3583-002		1101-123	1
549-3584-002		1101-65	2
549-3586-002		1101-138	1
549-3587-002		1101-135	1
549-3589-005		1101-106	1
549-3590-003		1101-101	1
549-3591-002		1101-144	1
549-3592-002		1101-66	1
549-3593-002		1101-15	1
546-3593-003		1101-15	1
546-3593-004		1101-15	1
549-3594-002		1101-8	1
549-3594-003		1101-8	1
549-3594-004		1101-8	1
549-3595-002		1101-182	1
549-3596-002		1101-122	1
549-3597-002		1101-72	1
549-3598-002		1101-151	1
549-3599-002		1101-154	1
549-3600-002		1101-113	1
549-3601-002		1101-77	1
549-3602-002		1101-145	1
549-3603-002		1101-50	1
549-3604-003		1101-142	1
549-3605-003		1101-140	1
549-3606-003		1101-4	1
549-3607-003		1101-1	1
549-3610-003		1101-59	1
549-3611-003		1101-188	1
549-3612-003		1101-42	1
549-3613-003		1101-35	1
549-3613-013		1101-35	1
549-3614-004		1101-186	1
549-3615-004		1101-30	1
549-3615-014		1101-30	1
549-3615-024		1101-30	1
549-3615-034		1101-30	1
549-3616-004		1101-27	1
549-3616-014		1101-27	1
549-3616-024		1101-27	1
549-3616-034		1101-27	1
549-3616-044		1101-27	1
549-3616-054		1101-27	1
549-3617-004		1101-24	1
549-3617-014		1101-24	1
549-3617-304		1101-25	1
549-3617-314		1101-26	1
549-3617-324		1101-25	1
549-3618-004		1101-21	1
549-3618-014		1101-21	1
549-3618-024		1101-21	1
549-3618-034		1101-21	1
549-3618-044		1101-21	1
549-3618-054		1101-21	1
549-3620-005		1101-201	1
549-3621-002		1101-139	2
553-2307-002		1101-67	1
553-2330-003		1101-99	1
553-4998-003		1101-127	5
553-9645-002		1101-162	1
553-9646-002		1101-163	1
553-9647-003		1101-158	1
553-9648-003		1101-164	1
553-9649-003		1101-157	1
553-9650-003		1101-106	1
553-9651-003		1101-101	1
553-9652-003		1101-90	1
554-8430-002		1101-11A	2
5555-25MD		1101-159	2
6328Y		1101-112	2
7S9911-1E		1101-174	1
756-6899-002		1101-181	1
756-9969-002		1101-21	2
757-3805-001		1101-5	1
757-3805-002		1101-12	1
757-3806-001		1101-18	1
757-3806-002		1101-11	1
757-3806-003		1101-18	1
757-3806-004		1101-11	1
757-5798-001		1101-21	1
757-5798-002		1101-30	1
757-5798-003		1101-26	1
757-5798-004		1101-25	1
757-5801-001		1101-186	1
8327S		1101-112	2
8328S		1101-112	2
8715		1101-28	6
8942		1101-63	4
8980-2 1-4		1101-83	4
8980-2 3-16		1101-61	2

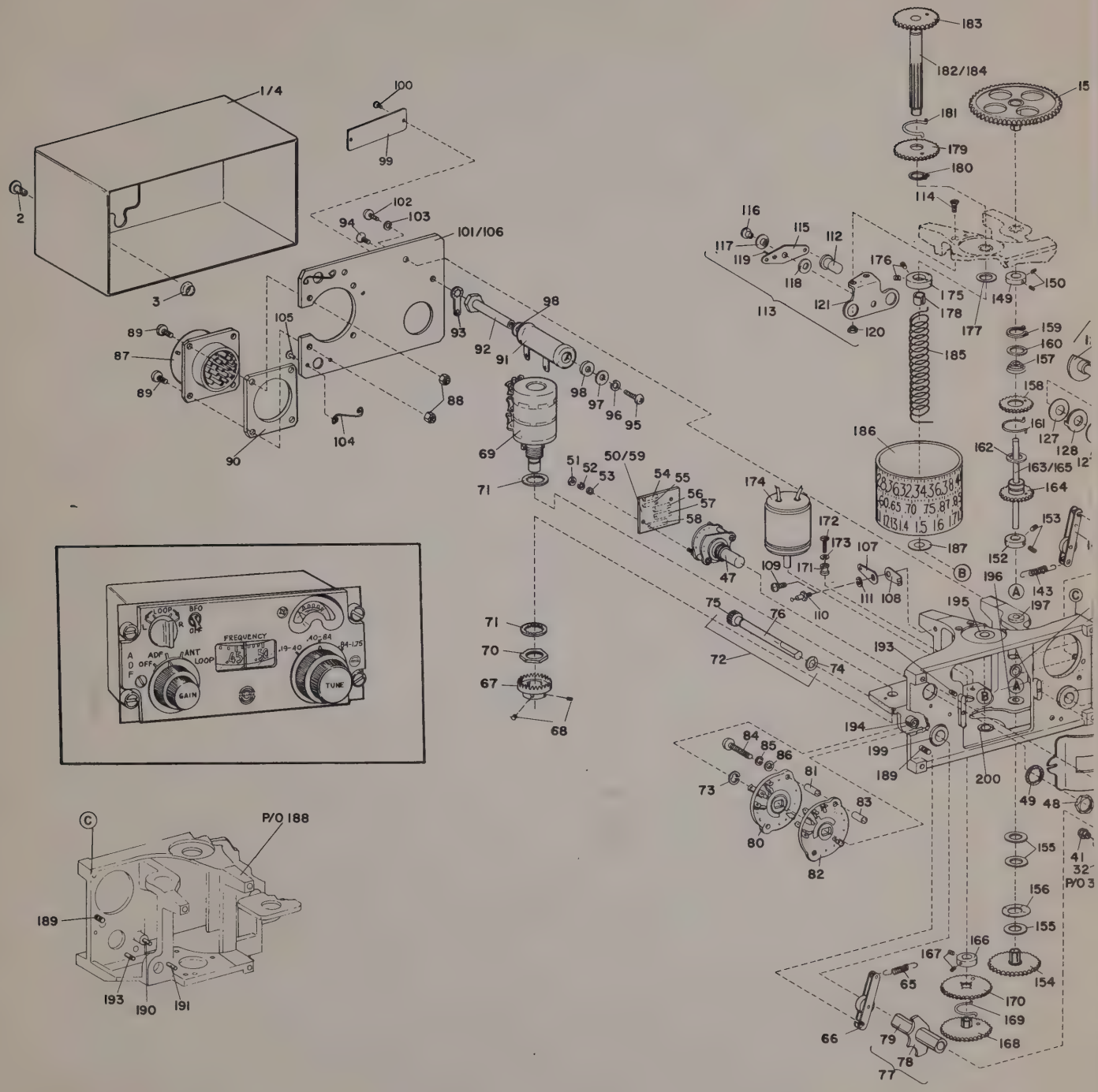
SYMBOL INDEX

SYMBOL	PART NUMBER	FIG. - ITEM
B301	TGC11C4	1101-174
B301	7RS911-1E	1101-174
E2	2045X	1101-110
M301	3200-021	1101-33
P301	MS24264B18B31PNX	1101-87
P301	BT02A20-41P	1101-87
R301	383-0195-00	1101-69
R303	RC20GF471K	1101-58
R304	RC20GF681K	1101-57
R305	RC20GF681K	1101-56
R306	RC07GF103K	1101-54
R306	RC07GF153K	1101-54
R306	RC07GF333K	1101-54
R306	RC07GF472K	1101-54
R307	RC07GF103K	1101-55
R307	RC07GF153K	1101-55
R307	RC07GF333K	1101-55
R307	RC07GF472K	1101-55
R308	RW31V250	1101-91
S301	T3103	1101-31
S302A	50230-4MLR	1101-82
S302B	50143	1101-80
S303	1212SMA00-0044-020	1101-47
S304	50148	1101-60
TB1	549-3610-003	1101-59
TB2	549-3615-004	1101-30
TB2	549-3615-014	1101-30

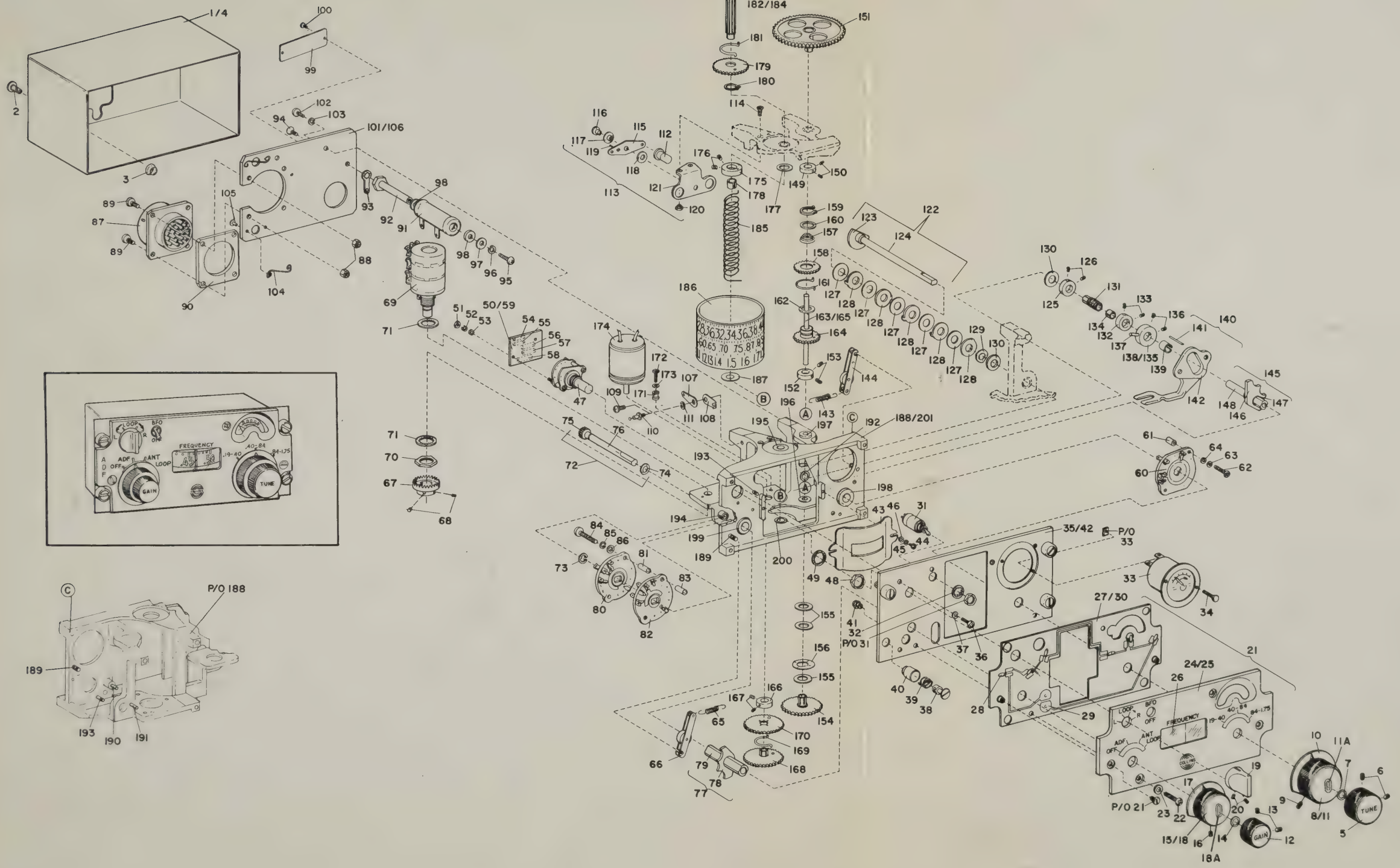
SYMBOL	PART NUMBER	FIG. - ITEM

COMMERCIAL HARDWARE LIST

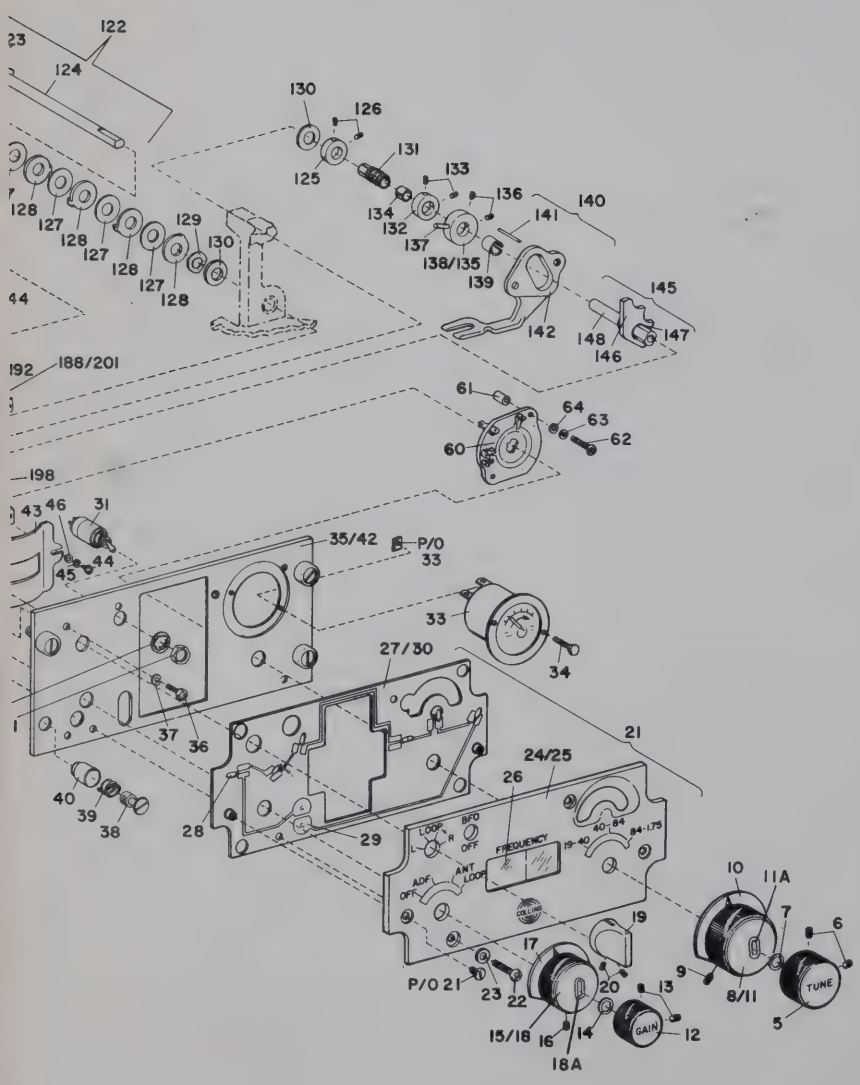
PART NUMBER	NOMENCLATURE
302-0262-00	WASHER, NONMETALLIC, PHEN, 0.116 ID, 0.187 OD, 0.031 THK
305-0170-00	RIVET, TUBULAR, AL, OVAL HD, 0.089 DIA X 0.151 LG SHK
305-0172-00	RIVET, TUBULAR, AL, OVAL HD, 0.089 DIA X 7/32 LG SHK
310-0048-00	WASHER, FLAT, SST, 0.172 ID, 0.437 OD, 0.036 THK
310-0070-00	WASHER, LOCK, SST, SR, 0.088 ID, 0.165 OD, 0.015 THK
310-0278-00	WASHER, LOCK, SST, SR, 0.115 ID, 0.202 OD, 0.020 THK
310-0447-00	WASHER, FLAT, SST, 0.147 ID, 0.437 OD, 0.031 THK
310-0552-00	WASHER, SPG TENS, CAD. PL STL, 0.166 ID, 0.307 OD, 0.067 THK
310-4714-00	WASHER, SPG TENS, CAD. PL PH BRZ, 17/64 ID, 1/2 OD, 0.010 THK
310-6320-00	WASHER, FLAT, SST, 0.092 ID, 7/32 OD, 0.018 THK
310-6323-00	WASHER, FLAT, SST, 0.251 ID, 5/8 OD, 0.017 THK
311-0097-00	PIN, GROOVED, HDLS, SST, 0.088 DIA X 0.375 LG
311-0139-00	PIN, GROOVED, HDLS, SST, 0.062 DIA X 3/8 LG
311-0145-00	PIN, GROOVED, HDLS, SST, 0.093 DIA X 1/2 LG
311-1577-00	PIN, GROOVED, HDLS, SST, 0.062 DIA X 5/16 LG
313-0037-00	NUT, PLAIN, HEX., SST, 2-56 THD
334-4120-00	NUT, PLAIN, HEX., SST, 3/8-32 THD
335-0020-00	SETSCREW, SST, 6-32 X 1/8 LG
342-0061-00	SCREW, MACH., SST, FH, 6-32 X 3/16 LG
342-0135-00	SCREW, MACH., SST, FH, 2-56 X 3/8 LG
343-0020-00	SCREW, MACH., SST, PAN HD, 4-40 X 5/16 LG
343-0122-00	SCREW, MACH., SST, PAN HD, 2-56 X 1/8 LG
343-0123-00	SCREW, MACH., SST, PAN HD, 2-56 X 3/16 LG
343-0126-00	SCREW, MACH., SST, PAN HD, 2-56 X 3/8 LG
343-0133-00	SCREW, MACH., SST, PAN HD, 4-40 X 1/4 LG
343-0135-00	SCREW, MACH., SST, PAN HD, 4-40 X 3/8 LG
343-0136-00	SCREW, MACH., SST, PAN HD, 4-40 X 7/16 LG
343-0140-00	SCREW, MACH., SST, PAN HD, 4-40 X 7/8 LG
343-0170-00	SCREW, MACH., SST, PAN HD, 6-32 X 7/16 LG
347-0007-00	SCREW, MACH., SST, FIL H, 4-40 X 5/16 LG
373-0085-00	WASHER, LOCK, SST, INT TEETH, 0.391 ID, 0.507 OD, 0.022 THK
373-0087-00	WASHER, LOCK, CAD. PL STL, INT TEETH, 0.267 ID, 0.408 OD, 0.018 THK
373-8020-00	WASHER, LOCK, SST, EXT TEETH, 0.150 ID, 0.317 OD, 0.020 THK



614L-8 ADF Control Unit
Figure 1101



614L-8 ADF Control Unit
Figure 1101


122
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128
145
142
148
147
146
192
188/201
61
64
63
60
62
198
43
46
31
44
45
35/42
P/O 33
33
34
27/30
37
36
40
39
38
28
29
21
24/25
26
LOOP
BFO
OFF
L
R
FREQUENCY
40-84
84-175
19-40
ADF
OFF
ANT
LOOP
10
11A
7
6
9
8/11
TUNE
5
19
17
P/O 21
23
22
20
13
15/18
16
14
GAIN
12
18A

GROUP ASSEMBLY PARTS LIST

	FIG. - ITEM	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY.
	1101 -	522-2357-00	614L-8 ADF CONTROL UNIT	A	1
		522-2357-011	614L-8 ADF CONTROL UNIT	B	1
		522-2357-012	614L-8 ADF CONTROL UNIT	C	1
		522-2357-013	614L-8 ADF CONTROL UNIT	D	1
		522-2357-014	614L-8 ADF CONTROL UNIT	E	1
		522-2357-016	614L-8 ADF CONTROL UNIT	F	1
		522-2357-017	614L-8 ADF CONTROL UNIT	G	1
		522-2357-018	614L-8 ADF CONTROL UNIT	H	1
		522-2357-019	614L-8 ADF CONTROL UNIT	J	1
R		522-2357-022	614L-8 ADF CONTROL UNIT	K	1
	- 1	549-3607-003	. COVER ASSY		1
	- 2	AJ3-25CAD ORZINCPL	. . STUD, TURNLOCK FASTENER V72794 012-1013-00		2
	- 3	GA3-200 CHROMATE	. . EYELET, TURNLOCK FASTENER V72794 012-1162-00		2
	- 4	549-3606-003	. . COVER ASSY		1
	- 5	549-3558-002	. KNOB	A,B C,D E,F G,J	1
R		757-3805-001	. KNOB	H,K	1
			ATTACHING PARTS		
	- 6	COML	. SETSCREW 335-0020-00 - - * - -		2
	- 7	500-1095-003	. WASHER, FLAT		1
	- 8	549-3594-002	. KNOB ASSY	A,B C,D E,F J	1
		549-3594-004	. KNOB ASSY	G	1
R		549-3594-003	. KNOB ASSY	H,K	1
			ATTACHING PARTS		
	- 9	COML	. SETSCREW 335-0020-00 - - * - -		1
	- 10	549-3563-002	. . SKIRT, KNOB	A,B C,D E,F G,J	
		549-3563-003	. . SKIRT, KNOB	H	1
	- 11	549-3561-002	. . KNOB	A,B C,D E,F J	1
		757-3806-004	. . KNOB	G	1
R		757-3806-002	. . KNOB	H,K	1
	- 11A	554-8430-002	. . BUSHING, SLV		1
	- 12	549-3559-002	. KNOB	A,B C,D E,F G,J	1
R		757-3805-002	. KNOB	H,K	1
			ATTACHING PARTS		
	- 13	COML	. SETSCREW 335-0020-00 - - * - -		2
	- 14	500-1095-003	. WASHER, FLAT		1
	- 15	549-3593-002	. KNOB ASSY	A,B C,D E,F J	1
		549-3593-004	. KNOB ASSY	G	1
R		549-3593-003	. KNOB ASSY	H,K	1

GROUP ASSEMBLY PARTS LIST

	FIG. - ITEM	PART NO.	1 2 3 4 5 6 7 NOMENCLATURE	USAGE CODE	UNITS PER ASSY.
			ATTACHING PARTS		
	1101 - 16	COML	. SETSCREW 335-0020-00		1
			- - * - -		
	- 17	549-3562-002	. . SKIRT, KNOB	A,B C,D E,F G,J	1
R		549-3562-003	. . SKIRT, KNOB	H,K	1
	- 18	549-3560-002	. . KNOB	A,B C,D E,F J	1
		757-3806-003	. . KNOB	G	1
R		757-3806-001	. . KNOB	H,K	1
	- 18A	554-8430-002	. . BUSHING, SLV		1
	- 19	549-3576-002	. KNOB	A,B C,D E,F J	1
		549-3576-004	. KNOB	G	1
R		549-3576-003	. KNOB	H,K	1
			ATTACHING PARTS		
	- 20	COML	. SETSCREW 335-0020-00		2
			- - * - -		
	- 21	549-3618-004	. PANEL, LIGHTING, 28 V, RED	A	1
		549-3618-014	. PANEL, LIGHTING, 28 V, WHITE	B	1
		549-3618-024	. PANEL, LIGHTING, 5 V, RED	C	1
		549-3618-034	. PANEL, LIGHTING, 5 V, WHITE	D,E G	1
R		549-3618-044	. PANEL, LIGHTING, 5V, WHITE	F,K	1
		757-5798-001	. PANEL, LIGHTING, 28 V, RED	H	1
		549-3618-054	. PANEL, LIGHTING, 28 V, WHITE	J	1
			ATTACHING PARTS		
	- 22	COML	. SCREW, MACH. 343-0020-00	A,B C,D E,G	2
R	- .	756-9969-002	. SCREW, MACH.	F,H J,K	2
	- 23	544-8809-003	. WASHER, RUB.		2
			- - * - -		
	- 24	549-3617-004	. . PANEL	A,B C,D E,G	1
R		549-3617-014	. . PANEL	F,J,K	1
		NO NUMBER	. . PANEL	H	1
	- 25	549-3617-304	. . . PANEL	A,B C,D E,G	1
R		549-3617-324	. . . PANEL	F,J,K	1
		757-5798-004	. . . PANEL	H	1
R	- 26	549-3617-314	. . . WINDOW, PLASTIC	A,B C,D E,F G,J,K	1
		757-5798-003	. . . WINDOW, PLASTIC	H	1
	- 27	549-3616-004	. . LIGHT ASSY, PANEL, 28 V, RED	A	1
		549-3616-014	. . LIGHT ASSY, PANEL, 28 V, WHITE	B	1
		549-3616-024	. . LIGHT ASSY, PANEL, 5 V, RED	C	1
R		549-3616-034	. . LIGHT ASSY, PANEL, 5 V, WHITE	D,E G,K	1

GROUP ASSEMBLY PARTS LIST

FIG. - ITEM	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY.
1101	549-3616-044	. . LIGHT ASSY, PANEL, 28 V, WHITE	F	1
	549-3616-054	. . LIGHT ASSY, PANEL, 28 V, WHITE	J	1
	NO NUMBER	. . LIGHT ASSY, PANEL, 28 V, RED	H	1
- 28	MS24367-1	. . . LAMP, INCANDESCENT V71744 262-0740-00	A,C H	6
	8715	. . . LAMP, INCANDESCENT V08719 262-1101-00	B,D E,F G,J,K	6
- 29	52032	. . . CONTACT, ELECTRICAL V02660 372-1956-00		2
- 30	549-3615-004	. . . PRINTED CIRCUIT BOARD TB2	A,B	1
*	549-3615-014	. . . PRINTED CIRCUIT BOARD TB2	C,D E,G,K	1
	549-3615-024	. . . PRINTED CIRCUIT BOARD TB2	F	1
	757-5798-002	. . . PRINTED CIRCUIT BOARD TB2	H	1
	549-3615-034	. . . PRINTED CIRCUIT BOARD TB2	J	1
- 31	T3103	. SWITCH, TGL V81640 266-5127-00 S301		1
		ATTACHING PARTS		
- 32	1214-05-00-0543	. WASHER, LOCK V78189 373-0087-00		1
		- - * - -		
- 33	3200-021	. AMMETER V81030 458-0344-00 M301		1
		ATTACHING PARTS		
- 34	549-3565-002	. SCREW, MACH.		2
		- - * - -		
- 35	549-3613-003	. SUBPANEL ASSY, FRONT	A,B C,D	1
	549-3613-013	. SUBPANEL ASSY, FRONT	E,G F,H J,K	1
		ATTACHING PARTS		
- 36	COML	. SCREW, MACH. 347-0007-00		4
- 37	MS35337-78	. WASHER, LOCK V79807 310-0278-00		4
		- - * - -		
- 38	PF3 1-2 38 CADPLYEL	. . STUD ASSY, TURNLOCK FASTENER V72794 012-1521-00		4
- 39	PS3 1-2 CADPLYEL	. . STUD ASSY, TURNLOCK FASTENER V72794 012-1522-00		4
- 40	PC3 1-2 CADPLYEL	. . STUD ASSY, TURNLOCK FASTENER V72794 012-1523-00		4
- 41	F22NCFMA2-40	. . NUT, SELF-LKG, CLINCH V72962 333-0840-00		2
- 42	549-3612-003	. . SUBPANEL ASSY, FRONT		1
- 43	549-3557-002	. MASK, DIAL		1
		ATTACHING PARTS		
- 44	MS35216-2	. SCREW, MACH. V77250 343-0123-00		2
- 45	MS35337-77	. WASHER, LOCK V79807 310-0070-00		2
- 46	COML	. WASHER, FLAT 310-6320-00		2
		- - * - -		
- 47	1212SMA00-0044-020	. SWITCH, ROT. V82104 259-1572-00 S303		1
		ATTACHING PARTS		
- 48	COML	. NUT, PLAIN, HEX. 334-4120-00		1
- 49	1720-02-00-4102	. WASHER, LOCK V78189 373-0085-00		1
		- - * - -		
- 50	549-3603-002	. RESISTOR ASSY		1
		ATTACHING PARTS		
- 51	MS35649-24	. NUT, PLAIN, HEX. V77250 313-0037-00		2

*LAMPS ARE IN PARALLEL FOR 5 V LIGHTING.

GROUP ASSEMBLY PARTS LIST

FIG. - ITEM	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY.
1101 - 52	MS35337-77	. WASHER, LOCK V79807 310-0070-00		2
- 53	COML	. WASHER, FLAT 310-6320-00		2
		- - * - -		
- 54	RC07GF333K	. . RESISTOR, FXD, 33,000 OHMS 10%, 1/4 W V01121 745-0803-00 R306 EFF THRU MCN 106		1
	RC07GF103K	. . RESISTOR, FXD, 10,000 OHMS 10%, 1/4 W V01121 745-0785-00 R306 EFF MCN 128 AND 129		1
	RC07GF472K	. . RESISTOR, FXD, 4700 OHMS 10%, 1/4 W V01121 745-0773-00 R306 EFF MCN 107 THRU 127, 130 THRU 405, 691 AND UP		1
	RC07GF153K	. . RESISTOR, FXD, 15,000 OHMS 10%, 1/4 W V01121 745-0791-00 R306 EFF MCN 406 THRU 690		1
- 55	RC07GF333K	. . RESISTOR, FXD, 33,000 OHMS 10%, 1/4 W V01121 745-0803-00 R307 EFF THRU MCN 106		1
	RC07GF103K	. . RESISTOR, FXD, 10,000 OHMS 10%, 1/4 W V01121 745-0785-00 R307 EFF MCN 128 AND 129		1
	RC07GF472K	. . RESISTOR, FXD, 4700 OHMS 10%, 1/4 W V01121 745-0773-00 R307 EFF MCN 107 THRU 127, 130 THRU 405, 691 AND UP		1
	RC07GF153K	. . RESISTOR, FXD, 15,000 OHMS 10%, 1/4 W V01121 745-0791-00 R307 EFF MCN 406 THRU 690		1
- 56	RC20GF681K	. . RESISTOR, FXD, 680 OHMS 10%, 1/2 W V01121 745-1345-00 R305		1
- 57	RC20GF681K	. . RESISTOR, FXD, 680 OHMS 10%, 1/2 W V01121 745-1345-00 R304		1
- 58	RC20GF471K	. . RESISTOR, FXD, 470 OHMS 10%, 1/2 W V01121 745-1338-00 R303		1
- 59	549-3610-003	. . TERMINAL BOARD TB1		1
- 60	50148	. SWITCH SECTION, ROT. V82104 269-2356-00 S304		1
- 61	8980-2 3-16	. SPACER, SLV V76854 269-1402-00 ATTACHING PARTS FOR 60 AND 61		2
- 62	MS35216-14	. SCREW, MACH. V77250 343-0135-00		2
- 63	8942	. WASHER, NONMETALLIC V76854 302-0262-00		2
- 64	MS35337-78	. WASHER, LOCK V79807 310-0278-00		2
		- - * - -		
R - 65	549-3584-002	. SPRING, TORSION		1
- 66	549-3592-002	. FOLLOWER, DETENT		1
- 67	553-2307-002	. GEAR, CROWN ATTACHING PARTS		1
- 68	COML	. SETSCREW 335-0020-00		2
		- - * - -		
- 69	383-0195-00	. ATTENUATOR, VAR, 2 SECT. 600 OHMS 1%, 2 W, THIRD SECT. 5000 OHMS 10%, 1/2 W R301 ATTACHING PARTS		1
- 70	COML	. NUT, PLAIN, HEX. 334-4120-00		1
- 71	1720-02-00-4102	. WASHER, LOCK V78189 373-0085-00		2
		- - * - -		
- 72	549-3597-002	. SHAFT ASSY ATTACHING PARTS		1
- 73	MS16633-1015	. RING, RETAINING V89462 340-0089-00		1
- 74	3502-07-01-0543D	. WASHER, SPG TENS V78189 310-0552-00		1
		- - * - -		

GROUP ASSEMBLY PARTS LIST

FIG. - ITEM	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY.
1101 - 75	549-3556-002	. . GEAR, SPUR		1
- 76	549-3547-002	. . SHAFT, SHOULDERED		1
- 77	549-3601-002	. SHAFT ASSY		1
- 78	549-3549-002	. . WHEEL, DETENT		1
- 79	549-3546-002	. . SHAFT, SHOULDERED		1
- 80	50143	. SWITCH SECTION, ROT. V82104 269-2358-00 S302B		1
- 81	8980-2 1-4	. SPACER, SLV V76854 269-1403-00		2
- 82	50230-4MLR	. SWITCH SECTION, ROT. V82104 269-2357-00 S302A		1
- 83	8980-2 1-4	. SPACER, SLV V76854 269-1403-00		2
		ATTACHING PARTS FOR 80 THRU 83		
- 84	MS35216-19	. SCREW, MACH. V77250 343-0140-00		2
- 85	MS35337-78	. WASHER, LOCK V79807 310-0278-00		2
- 86	8942	. WASHER, NONMETALLIC V76854 302-0262-00		2
		- - * - -		
	549-3541-00	. WIRING HARNESS	A,B J	1
	549-3541-011	. WIRING HARNESS	C,D G,K	1
	549-3541-012	. WIRING HARNESS	E,F H	1
	549-3541-013	. WIRING HARNESS		1
- 87	BT02A20-41P	. . CONNECTOR, RECP V09922 371-2126-00 P301	A,B C,D G,J,K	1
	MS24264B18B 31PNX	. . CONNECTOR, RECP V77820 359-4021-00 P301	E,F H	1
		ATTACHING PARTS		
- 88	MS2065D440A	. . NUT, SELF-LKG, HEX. V72962 333-0347-00		4
- 89	MS35216-14	. . SCREW, MACH. V77250 343-0135-00	A,B C,D G,J,K	4
	MS35216-15	. . SCREW, MACH. V77250 343-0136-00	E,F H	4
		- - * - -		
- 90	553-9652-003	. SPACER, PLATE	E,F H	1
- 91	RW31V250	. RESISTOR, FXD, 25 OHMS 5%, 14 W V91637 747-0732-00 R308		1
- 92	015-0553-00	. POST, ELECTRICAL-MECHANICAL EQUIP.		1
- 93	4012 1-4 HOTTINNED	. TERMINAL, LUG V77147 304-2800-00 EFF THRU MCN 106		1
		ATTACHING PARTS FOR 91 THRU 93		
- 94	MS35200-24	. SCREW, MACH. V77250 342-0061-00		1
- 95	MS35216-26	. SCREW, MACH. V77250 343-0170-00		1
- 96	MS35335-58	. WASHER, LOCK V78189 373-8020-00		1
- 97	COML	. WASHER, FLAT 310-0447-00		1
- 98	302-0347-00	. INSULATOR, WASH.		2
		- - * - -		
- 99	553-2330-003	. PLATE, IDENT		1
		ATTACHING PARTS		
-100	MS35216-1	. SCREW, MACH. V77250 343-0122-00		2
		- - * - -		
-101	549-3590-003	. PLATE, RETAINING	A,B C,D G,J,K	1
	553-9651-003	. PLATE, RETAINING	E,F H	1
		ATTACHING PARTS		
-102	MS35216-12	. SCREW, MACH. V77250 343-0133-00		3

GROUP ASSEMBLY PARTS LIST

	FIG. - ITEM	PART NO.	1 2 3 4 5 6 7 NOMENCLATURE	USAGE CODE	UNITS PER ASSY.
	1101-103	MS35337-78	. WASHER, LOCK V79807 310-0278-00		3
			- - * - -		
	-104	S3-150 CHROMATE	. . LOCKSPRING, TURNLOCK FASTENER V72794 012-1194-00		2
			ATTACHING PARTS		
	-105	R4008X1-8 CHROMATEDP	. . RIVET, TUBULAR V12014 305-0170-00		4
			- - * - -		
	-106	549-3589-005	. . PLATE, RETAINING	A,B C,D G,J	1
		553-9650-003	. . PLATE, RETAINING	E,F H	1
	-107	3017-4 HOTTINNED	. TERMINAL, LUG V77147 304-3000-00 EFF THRU MCN 106		1
	-108	SPL4040-4 HOTTINNED	. TERMINAL, LUG V77147 304-0332-00		1
			ATTACHING PARTS FOR 107 AND 108		
	-109	MS35216-12	. SCREW, MACH. V77250 343-0133-00 EFF THRU MCN 106		1
	-110	2045X	. TERMINAL, STUD V71279 306-0961-00 EFF MCN 107		1
	-111	MS35337-78	. WASHER, LOCK V79807 310-0278-00		1
			- - * - -		
R	-112	MS25237-327R	. LAMP, INCANDESCENT V08806 262-0179-020	A,H	2
		8327S	. LAMP, INCANDESCENT V08719 262-2067-00	B,J	2
		6328Y	. LAMP, INCANDESCENT V08719 262-0654-00	C	2
R		8328S	. LAMP, INCANDESCENT V08719 262-2066-00	D,E F,G,K	2
	-113	549-3600-002	. LAMPHOLDER		1
			ATTACHING PARTS		
	-114	MS35200-5	. SCREW, MACH. V77250 342-0135-00		2
			- - * - -		
	-115	549-3571-002	. . CLAMP, ELECTRICAL		1
			ATTACHING PARTS		
	-116	R4008X7-32 CHROMATEDP	. . RIVET, TUBULAR V12014 305-0172-00		1
	-117	549-3572-002	. . WASHER, SHOULDERED		1
	-118	548-9540-003	. . WASHER, PLASTIC		1
			- - * - -		
	-119	SS5169	. . TERMINAL, STUD V86577 306-0983-00		1
	-120	F22NCFMA1-26	. . NUT, SELF-LKG, CLINCH V72962 333-0837-00		2
	-121	549-3564-002	. . BRACKET, LAMP		1
	-122	549-3596-002	. SHAFT ASSY		1
	-123	549-3583-002	. . HUB, STOP		1
	-124	549-3544-002	. . SHAFT, SHOULDERED		1
	-125	548-6761-002	. COLLAR, SHAFT		1
			ATTACHING PARTS FOR 124 AND 125		
	-126	COML	. SETSCREW 335-0020-00		2
			- - * - -		
	-127	503-0644-001	. WASHER, FLAT EFF THRU MCN 189		5
		553-4998-003	. WASHER, FLAT EFF MCN 190		5
	-128	503-0643-001	. WASHER, STOP		5
	-129	3502-070-01-0543D	. WASHER, SPG TENS V78189 310-0552-00		1
	-130	COML	. WASHER, FLAT 310-0048-00		2
	-131	549-3555-002	. GEAR, WORM		1
	-132	548-6761-002	. COLLAR, SHAFT		1

GROUP ASSEMBLY PARTS LIST

FIG. - ITEM	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY.
1101		ATTACHING PARTS		
-133	COML	. SETSCREW 335-0020-00		2
		- - * - -		
-134	549-3580-002	. BEARING, SLV		1
-135	549-3587-002	. COLLAR, SHAFT		1
		ATTACHING PARTS		
-136	COML	. SETSCREW 335-0020-00		2
		- - * - -		
-137	GP4-062X 0375-50	. . PIN, GROOVED, HDLS V73957 311-0139-00		1
-138	549-3586-002	. . COLLAR, SHAFT		1
-139	549-3621-002	. BEARING, SLV		1
-140	549-3605-003	. LEVER, DRUM DIAL		1
-141	DLB-0625X 312-50	. . PIN, GROOVED, HDLS V83584 311-1577-00		1
-142	549-3604-003	. . LEVER, DRUM DIAL		1
-143	549-3574-002	. SPRING, HELICAL, EXTENSION		1
-144	549-3591-002	. FOLLOWER, DETENT		1
-145	549-3602-002	. SHAFT ASSY		1
-146	549-3548-002	. . WHEEL, DETENT		1
-147	549-3570-002	. . BEARING, SLV		1
-148	549-3545-002	. . SHAFT, SHOULDERED		1
-149	548-6761-002	. COLLAR, SHAFT		1
		ATTACHING PARTS		
-150	COML	. SETSCREW 335-0020-00		2
		- - * - -		
-151	549-3598-002	. GEAR, SPUR		1
-152	548-6761-002	. COLLAR, SHAFT		1
		ATTACHING PARTS		
-153	COML	. SETSCREW 335-0020-00		2
		- - * - -		
-154	549-3599-002	. GEAR, SPUR		1
-155	COML	. WASHER, FLAT 310-6323-00		3
-156	COML	. WASHER, SPG TENS 310-4714-00		1
-157	553-9649-003	. SPRING, HELICAL, COMPRESSION EFF MCN 258 THRU 356, 367 AND UP		1
-158	549-3581-002	. GEAR, HELICAL EFF THRU MCN 257		1
	553-9647-003	. GEAR, HELICAL EFF MCN 258 THRU 356, 367 AND UP		1
		ATTACHING PARTS		
-159	5555-25MD	. RING, RETAINING V79136 340-0270-00 EFF THRU MCN 257		1
	5100-25C	. RING, RETAINING V89462 340-0038-00 EFF MCN 258 THRU 356, 367 AND UP		1
-160	545-7507-003	. WASHER, FLAT EFF MCN 258 THRU 356, 367 AND UP		1
		- - * - -		
-161	549-3584-002	. SPRING, TORSION		1
-162	553-9645-002	. WASHER, THRUST EFF MCN 258 THRU 356, 367 AND UP		1
-163	549-3582-002	. GEAR AND SHAFT EFF THRU MCN 257		1
	553-9646-002	. GEAR AND SHAFT EFF MCN 258 THRU 356, 367 AND UP		1
-164	549-3575-002	. . GEAR, HELICAL EFF THRU MCN 257		1
	553-9648-003	. . GEAR, HELICAL EFF MCN 258 THRU 356, 367 AND UP		1
-165	549-3568-002	. . SHAFT, SHOULDERED		1
-166	548-6761-002	. COLLAR, SHAFT		1
		ATTACHING PARTS		
-167	COML	. SETSCREW 335-0020-00		2
		- - * - -		

GROUP ASSEMBLY PARTS LIST

FIG. - ITEM	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY.
1101 -168	549-3552-002	. GEAR, SPUR		1
-169	542-4177-002	. SPRING, LOAD		1
-170	549-3553-002	. GEAR, SPUR		1
-171	542-4160-002	. CLAMP, RIM CLENCHING		3
		ATTACHING PARTS		
-172	MS35216-5	. SCREW, MACH. V77250 343-0126-00		3
-173	MS35337-77	. WASHER, LOCK V79807 310-0070-00		3
		- - * - -		
-174	TGC11C4	. SYNCHRO, XMTR V86197 229-3000-00 B301		1
		OR		
R	7RS911-1E	. SYNCHRO, XMTR V88818 229-3001-00 B301		
-175	549-3566-002	. COLLAR, SHAFT		1
		ATTACHING PARTS		
-176	COML	. SETSCREW 335-0020-00		2
		- - * - -		
-177	545-7507-003	. WASHER, FLAT		1
-178	549-3621-002	. BEARING, SLV		1
-179	549-3573-002	. GEAR, SPUR		1
		ATTACHING PARTS		
-180	5555-25MD	. RING, RETAINING V79136 340-0270-00		1
		EFF THRU MCN 257		
	5100-25C	. RING, RETAINING V89462 340-0038-00		1
		EFF MCN 258 THRU 356, 367 AND UP		
		- - * - -		
-181	542-4177-002	. SPRING, LOAD EFF THRU MCN 665		1
	756-6899-002	. SPRING, LOAD EFF MCN 666		1
-182	549-3595-002	. GEAR AND SHAFT		1
-183	549-3578-002	. . GEAR, SPUR		1
R -184	549-3542-002	. . SHAFT, STRAIGHT		1
-185	549-3543-002	. SPRING, HELICAL, COMPRESSION		1
-186	549-3614-004	. DIAL, DRUM	A,B C,D E,F G,J,K	1
	757-5801-001	. DIAL, DRUM	H	1
-187	545-7507-003	. WASHER, FLAT		1
-188	549-3611-003	. FRAME, CONTROL BOX		1
-189	549-3577-002	. . HOLDER, DETENT ARM		1
-190	GP4-093X 0500-50	. . PIN, GROOVED, HDLS V73957 311-0145-00		1
-191	GP4-062X 0375-50	. . PIN, GROOVED, HDLS V73957 311-0139-00		1
-192	A288-1MILL 6085	. . BEARING, SLV V70417 309-0071-00		1
-193	GP7-093X375-50	. . PIN, GROOVED, HDLS V73957 311-0097-00		2
-194	F209-1MILL 6085A	. . BEARING, SLV V70417 309-0126-00		1
-195	F346-4MILL 6085A	. . BEARING, SLV V70417 309-0124-00		1
		EFF THRU MCN 250		
	A316MILL6085	. . BEARING, SLV V70417 309-0018-00		1
		EFF MCN 251		
-196	F346-4MIL 6085A	. . BEARING, SLV V70417 309-0124-00		1
-197	F346-4MILL 6085A	. . BEARING, SLV V70417 309-0124-00		1
-198	309-0062-00	. . BEARING, SLV		1
-199	F304-4MILL 6085A	. . BEARING, SLV V70417 309-0119-00		1
-200	A206-6MILL 6085	. . BEARING, SLV V70417 309-0055-00		1
-201	549-3620-005	. . FRAME, CONTROL BOX		1

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